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# Making Missouri a National Leader in Mathematics, Engineering, Technology and Science



A DATA BOOK FOR GOVERNOR BLUNT'S SUMMIT

April 25, 2006

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Prepared by Building Engineering and Science Talent

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## About this Data Book

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The purpose of this data book is to provide a shared baseline of analysis to support Governor Blunt's Summit on April 25, 2006, on building Missouri's capacity in mathematics, engineering, technology and science. A sustainable initiative requires a firm grasp of the big picture. The data presented have been assembled over the past three months to illuminate challenges and opportunities facing the state as a whole. The data book is meant to help start a conversation across the state and to provide a foundation that can be strengthened in the future. An in-depth look at pockets of excellence in Missouri would be equally valuable, and warrants future consideration.

BEST wishes to thank the Ewing Marion Kauffman Foundation for sponsoring this effort, as well as the Summit Planning Committee for providing essential insights and data. Mary Beth Luna in Governor Blunt's office played an indispensable role in coordinating the input of state agencies, while The Boeing Company contributed the printing of the data book. The BEST team that produced it includes: Gina Gianzero, senior research associate; Brenda Sullivan, director of communications, and John Yochelson, president.

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# I. Why METS Matters

## NATIONAL INDICATORS

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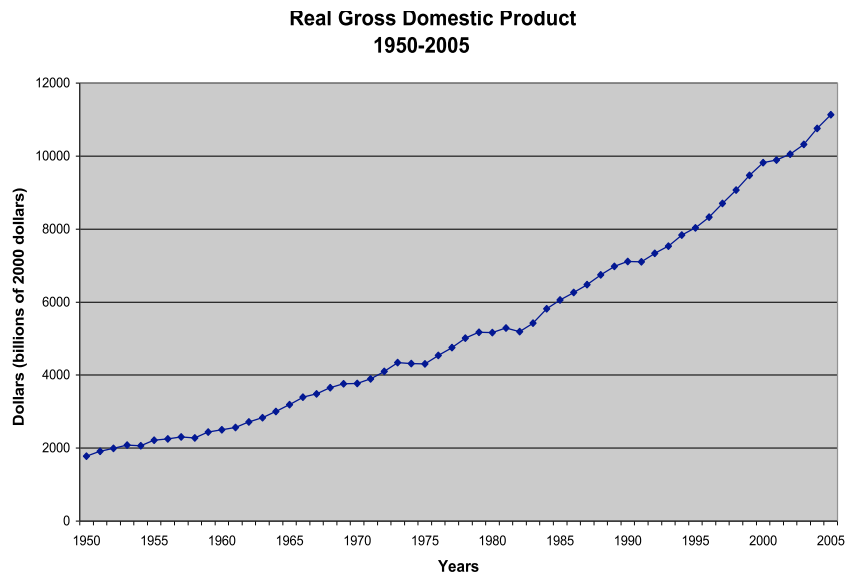
The United States comprises five percent of the world's population and produces 20 percent of global economic output. Technological innovation lies at the heart of this economic capacity. Half of our nation's growth stems from the creation of new knowledge and its translation into high-value products and services. The power that flows from U.S. strength in mathematics, engineering, technology and science (METS) makes the U.S. workforce the world's most productive and underpins the world's highest standard of living.

U.S. leadership cannot be taken for granted in today's global economy. Others are racing to catch up - making investments in education, infrastructure, and R&D that will position them to capture the high end of the value chain. A recent report of the National Academy of Sciences aptly described the forces at work as a "gathering storm" that requires a nationwide call to action. This section highlights some of the international and domestic indicators that have made METS a focal point of concern in the President's 2006 State of the Union Address, in Congress, among visionary governors, and at highest levels of the business and research communities.



# The Foundation of Prosperity

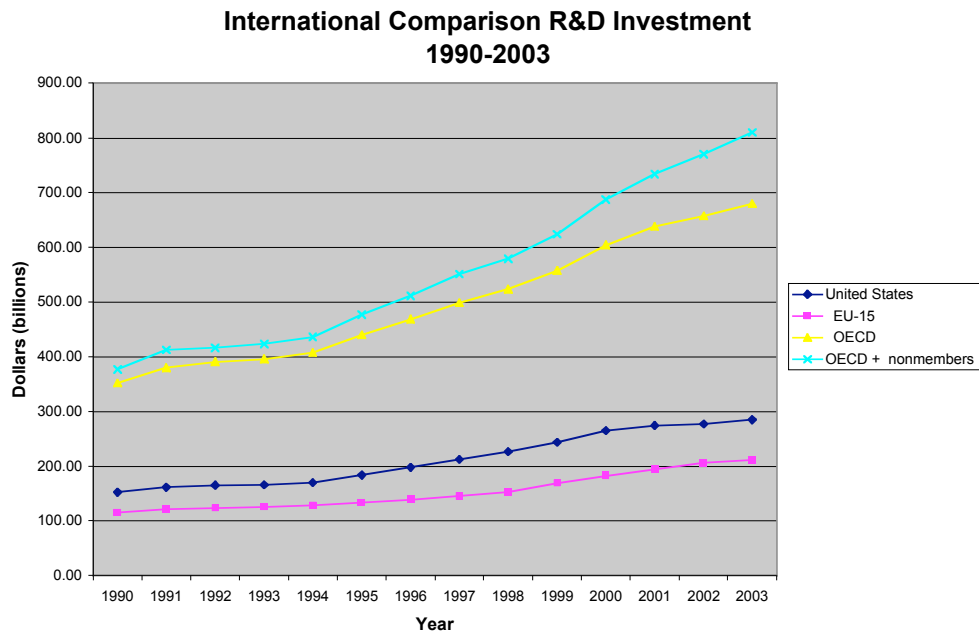
Technological innovation accounts for 50% of U.S. growth.\*



\* Michael J. Boskin and Lawrence J. Lau. 1992. *Capital, Technology, and Economic Growth*. In Nathan Rosenberg, Ralph Landau, and David C. Mowery, eds. *Technology and the Wealth of Nations*. Stanford University Press. Stanford, CA.

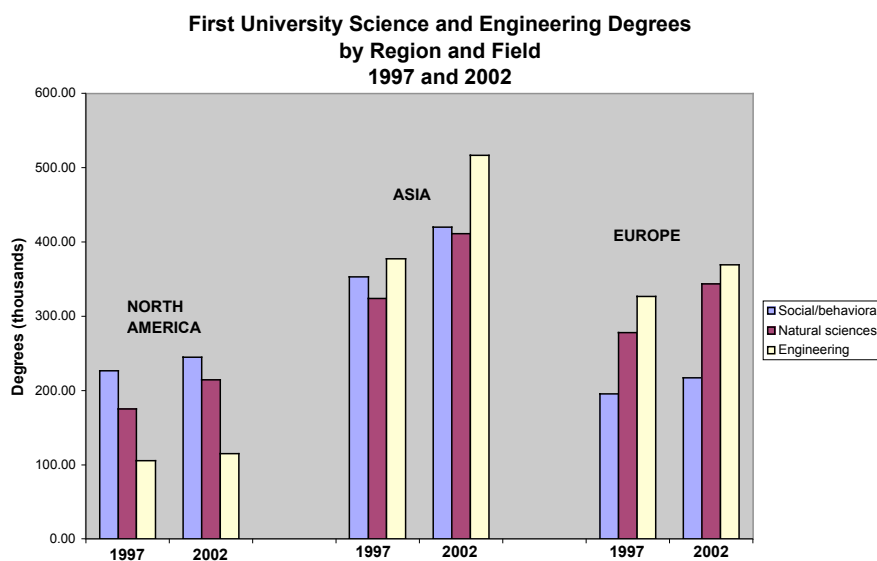
## Increased Competition

Global investment in R&D is surging.



*Note: the OECD is the Organization for Economic Cooperation and Development, which consists of 30 advanced industrial economies that share a commitment to democratic government and the market economy.*

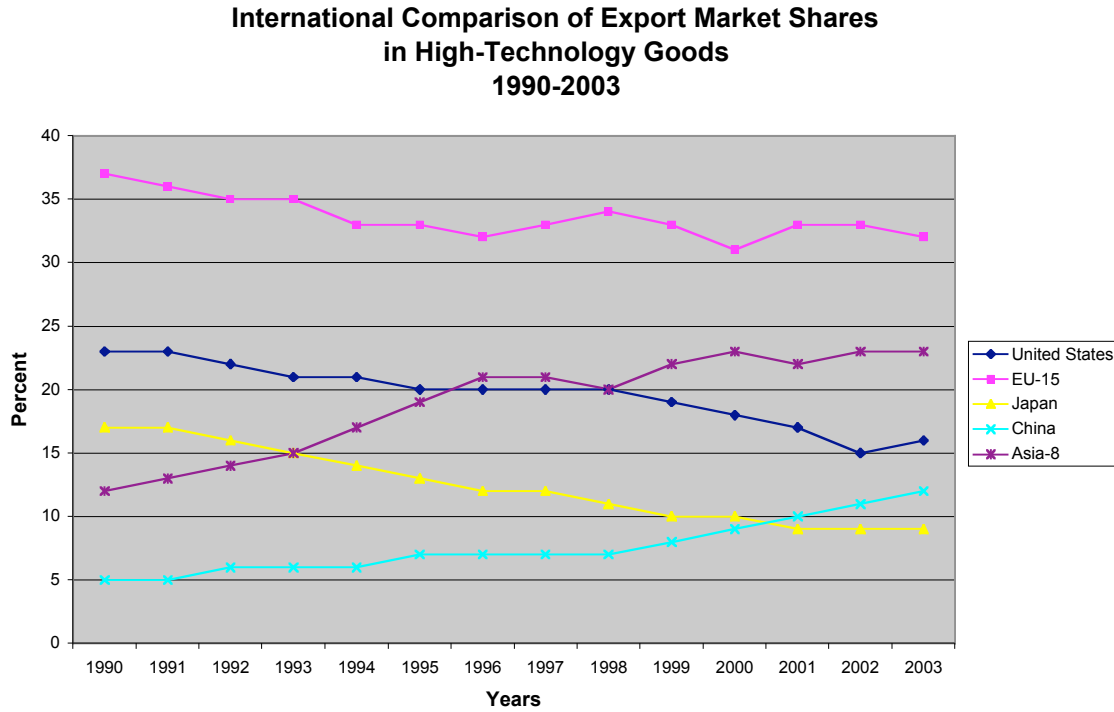
The global pool of technical talent is growing more rapidly in Asia and Europe than in North America.





## Increased Competition (cont'd.)

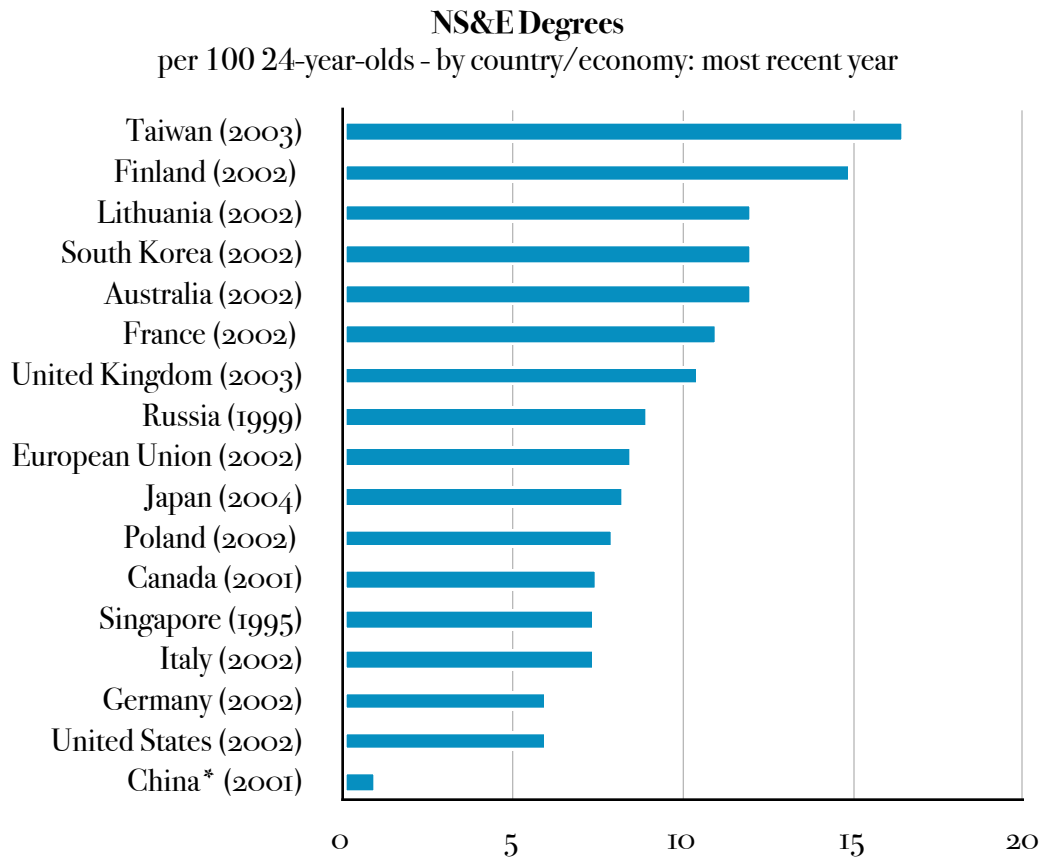
The U.S. share of high-technology goods in export markets is shrinking.



Source: National Science Foundation, Science and Engineering Indicators 2006, Figure O-11

## The U.S. Talent Pool

American students earn proportionately fewer degrees in METS.

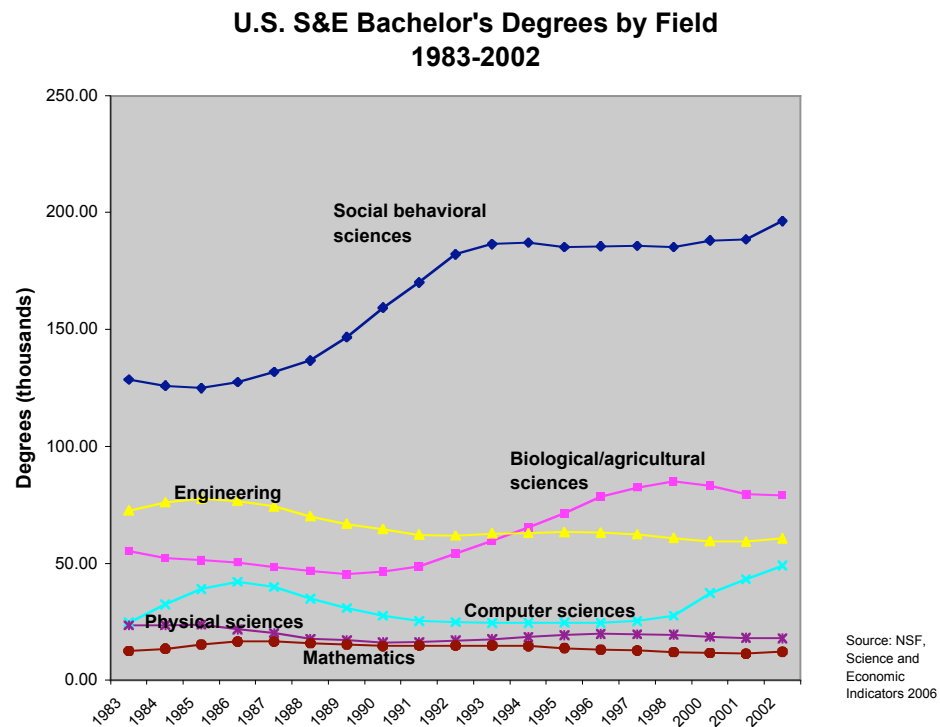


*\*Note: China's low ratio reflects the size of its population rather than its momentum in building capacity in METS. China tripled its enrollment in higher education from 2.15 million to 6.29 million between 1998 and 2003. Forty-five percent of Chinese undergraduates major in natural science or engineering.*

*Source: NSF, Science and Economic Indicators 2006, Figure O-24*

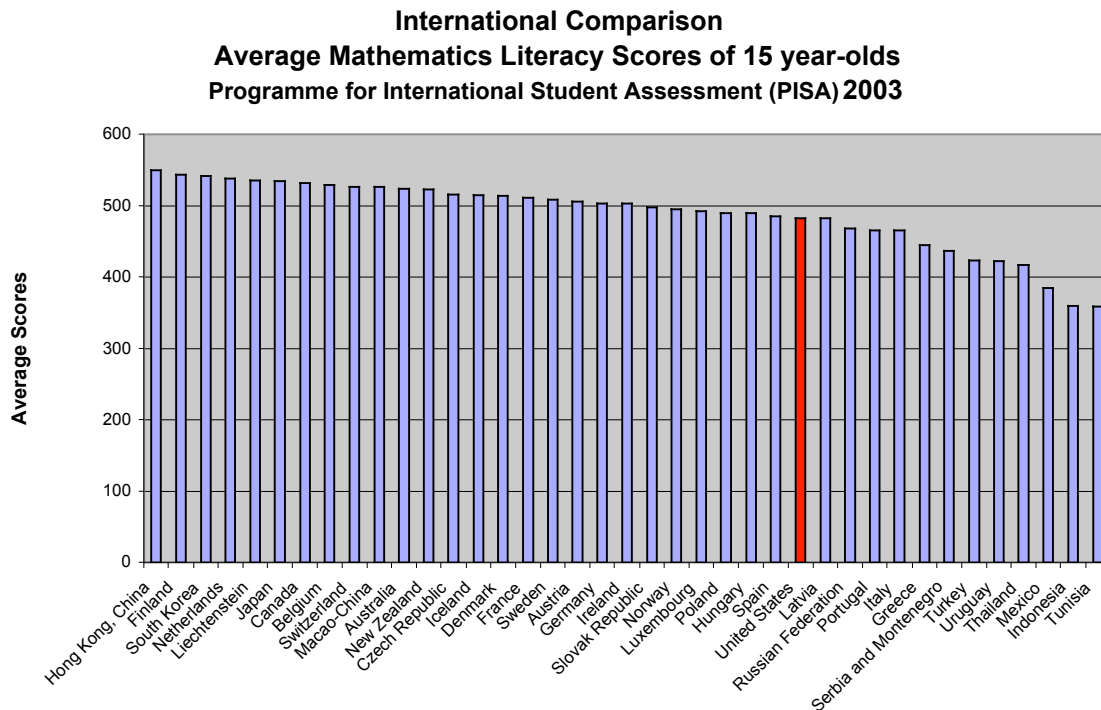
## The U.S. Talent Pool (cont'd.)

With few exceptions, U.S. bachelor degree production in METS has dropped or remained relatively flat during the past two decades.



## The U.S. Talent Pool (cont'd.)

American K-12 students do not measure up in international comparisons\* of math and science achievement.



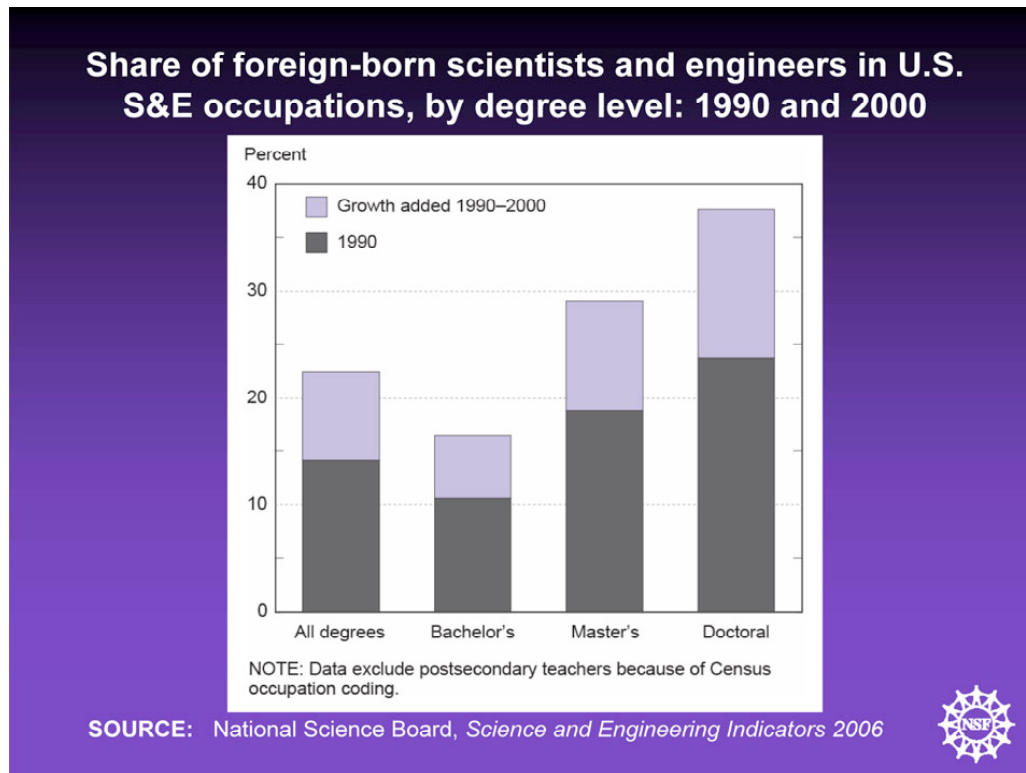
Source: National Science Foundation, Science and Engineering Indicators, 2006, Appendix Table 1-13

*\*Note: U.S. 15-year-olds scored below average on the 2003 OECD-administered Program for International Student Assessment (PISA), a measure of students' ability to apply scientific and mathematical concepts and skills.*

*The results of the widely recognized Third International Math and Science Study (TIMSS) will be discussed at Governor Blunt's summit on April 25.*

## The U.S. Talent Pool (cont'd.)

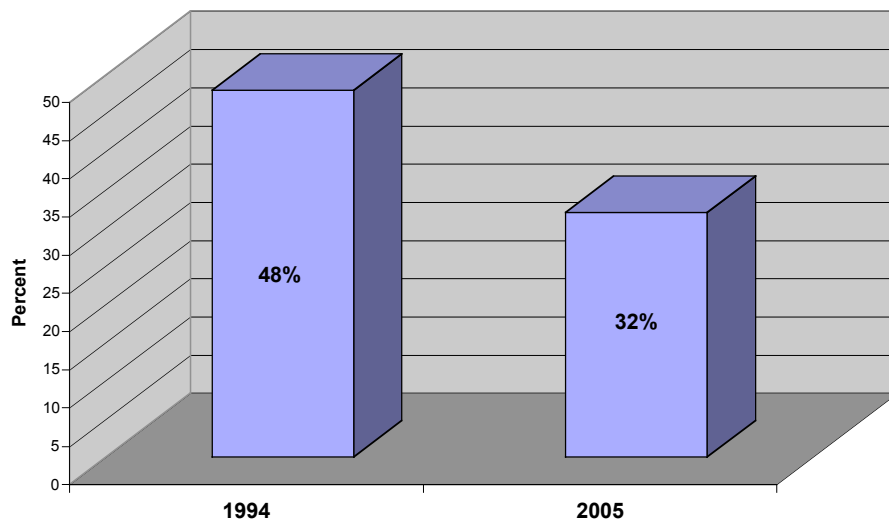
The U.S. is increasingly relying on foreign-born professionals in scientific and technical fields.



## The U.S. Talent Pool (cont'd.)

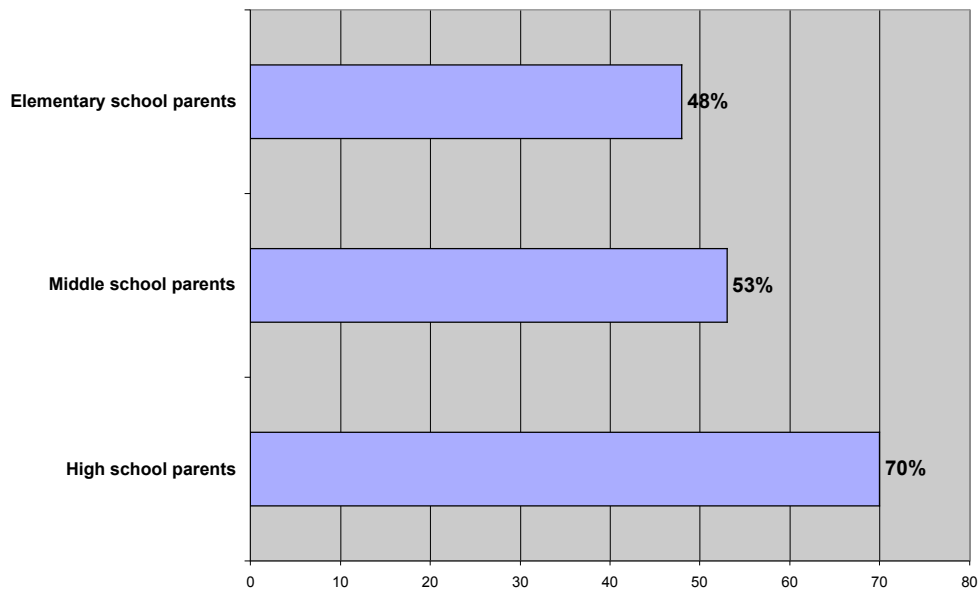
There is a lack of parental pressure to raise the K-12 bar in math and science.

**Fewer Parents Think Their Children Need More Math and Science**



Source: Education Insights at Public Agenda, Reality Check 2006

**High School Parents Most Pleased with Amount of Math and Science**

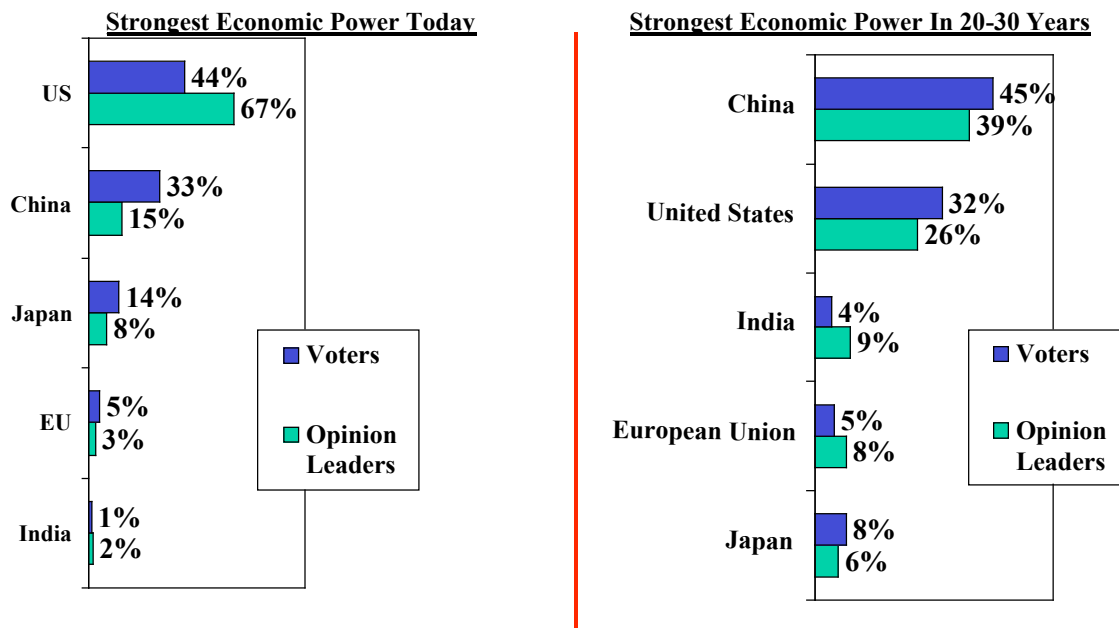


Source: Education Insights at Public Agenda, Reality Check 2006

## The U.S. Talent Pool (cont'd.)

Many Americans believe that the United States will be overtaken as the world's leading economic power.

### Public Perceptions of U.S. Economic Power



Source: U.S. Innovation and Competitiveness Addressing the Talent Gap, Business Roundtable sponsored Public Opinion Research, 2006.

## Why METS Matters for the U.S.: The Bottom Line

- Globalization has increased incentives around the world to develop technical talent.
- Other economies are investing aggressively in METS education.
- U.S. production of homegrown human capital is not keeping pace.
- Most parents are complacent regarding the need for more rigorous math and science education.
- The U.S. innovation enterprise relies increasingly on inflows of foreign-born professionals.

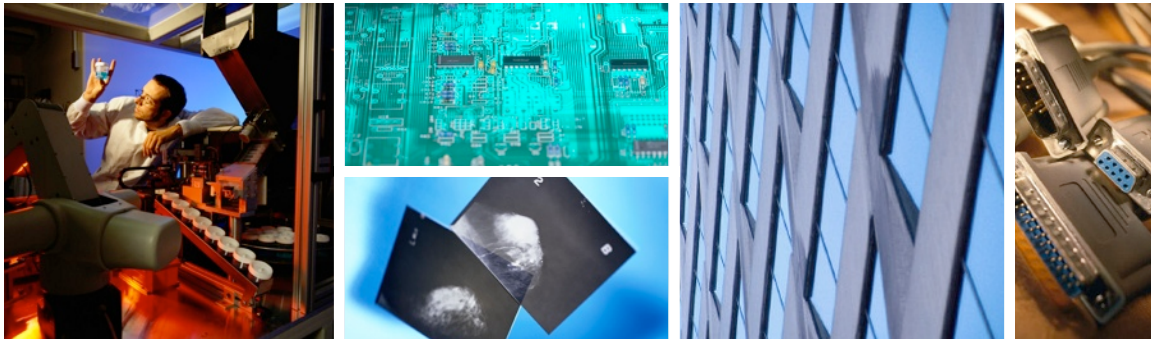


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# Why METS Matters

## MISSOURI INDICATORS

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Missouri stands out as one of the nation's most balanced and strategically located economies. The challenge inherent in this position is ensuring that Missouri is at the forefront of a varied range of economic sectors in order to compete nationally and internationally.

Agriculture, advanced manufacturing, life sciences, health care, and information-based services all matter. All of these hi-tech sectors are grounded in METS. Missouri will not be able to hold its own without a skilled workforce, a deep pool of technical talent, and world class institutions of higher education. This section highlights how much METS skills and METS-based industries mean not only to the economic future of Missouri as a whole, but also to the opportunities of individuals and families. Indicators in this section underscore the high stakes that hang in the balance of the state's efforts to build capacity in METS.

**Missouri is geographically well-positioned to compete.**

Missouri is within 500 miles of:

- 43% of U.S. population and households
- 41% of total U.S. effective buying income (all personal income after taxes)
- 39% of total U.S. retail sales (over \$2 trillion annually for retail merchandise)
- 41% of total U.S. service industries (over 2 million establishments)
- 44% of total U.S. manufacturing establishments (over 386,000 plants)

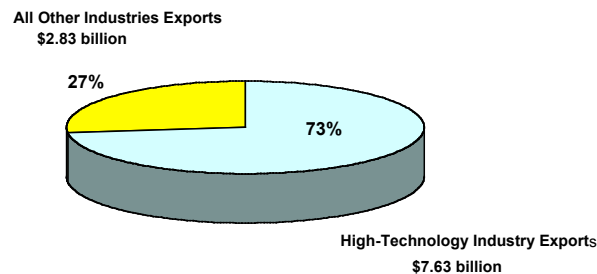


Source: MERIC

## The Economic Multiplier of METS

METS accounts for eight percent of the state's total employment, but METS-based industries account for three-quarters of Missouri's \$10.6 billion in products and services exported in 2005.

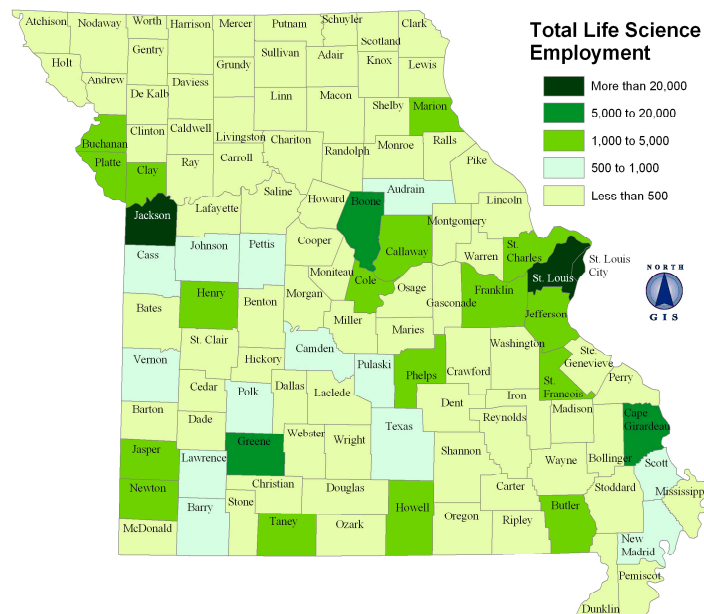
High-Technology Industry Exports  
as a Percentage of All Missouri Exports  
2005



Source: WISER and  
MERIC

In life sciences alone, 2,100 firms employ 183,000\* Missourians.

Missouri Life Science Employment by County 2004



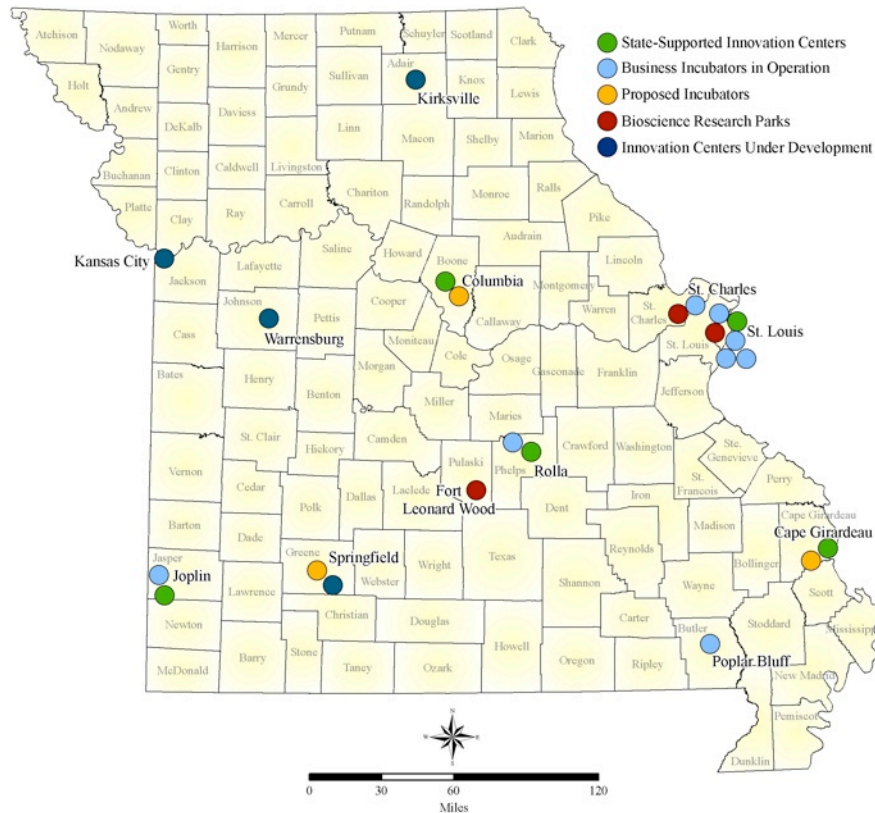
Source: MERIC, Missouri Life Science 2004

\*Note: This figure includes total company employment, not simply METS professionals.

## The Economic Multiplier of METS (cont'd.)

Missouri is seeding METS-based innovation across the state.

### Missouri Innovation Assets

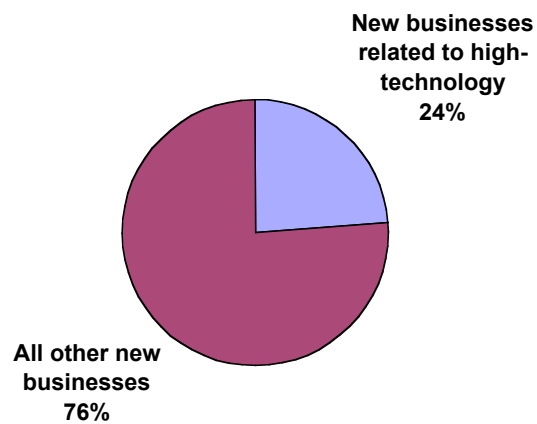


Source: Missouri Department of Economic Development / MERIC

## *The Economic Multiplier of METS (cont'd.)*

About a quarter of all new business formations in Missouri are related to METS-based industries.

**New Missouri Businesses Related to High-Technology  
2005**

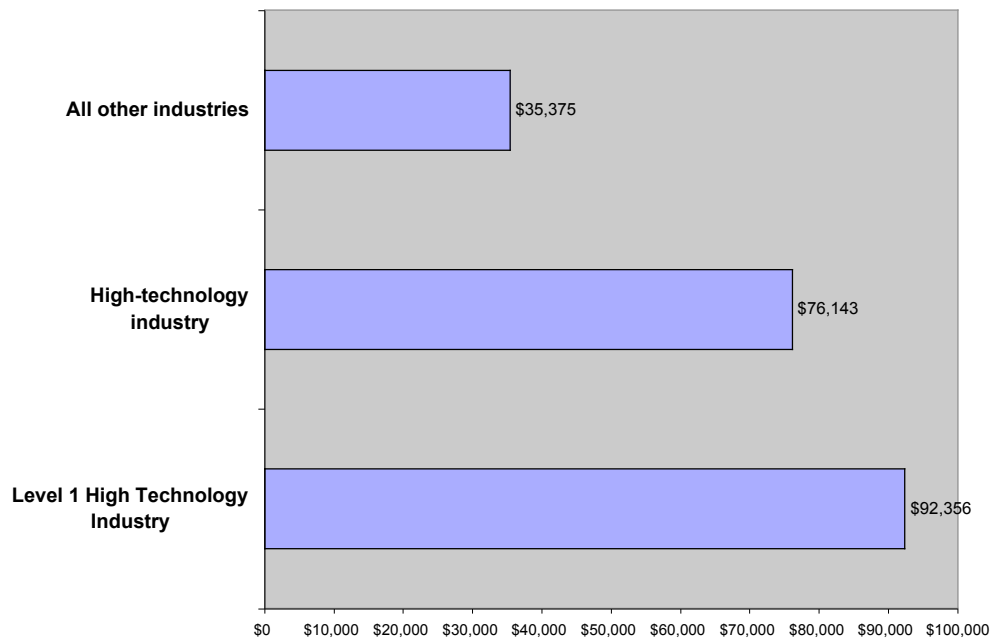


Source: MERIC

## Wages

Missouri's high technology industries pay higher than the average wage for all industries.

**High-Technology Wages Versus Other Industry Wages 2005**

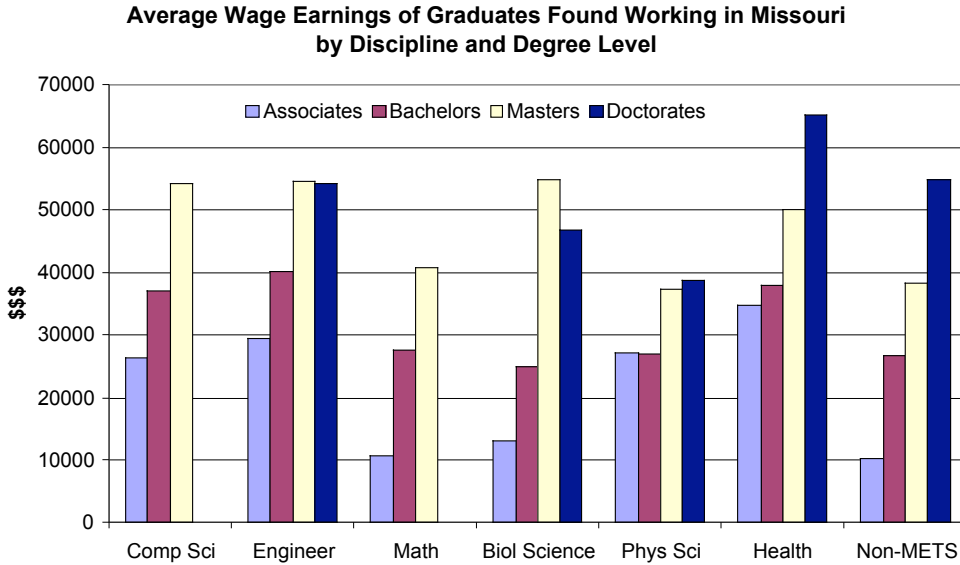


High-tech industries are defined as industries in which technology-oriented occupations account for about 9 percent or greater of total industry employment. Level I High Tech Industries technology occupations account for roughly 25 percent or greater of industry employment.

Source: MERIC

## Wages (cont'd.)

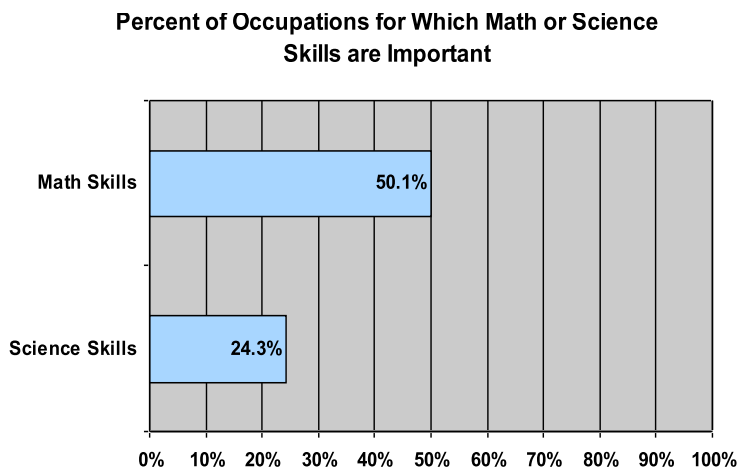
Recent METS graduates\* generally earn higher average annual wages than their counterparts in non-METS fields.



Source: DHE Administrative records (EMSAS) and DOLIR Wage Records (Quarter 2, 2005)  
Physical Sciences include CIP codes 40 and 41; Engineering includes CIP codes 14 and 15

\* Note: Data for doctorates not available for all disciplines.

Math and science literacy is essential in many occupations.\*



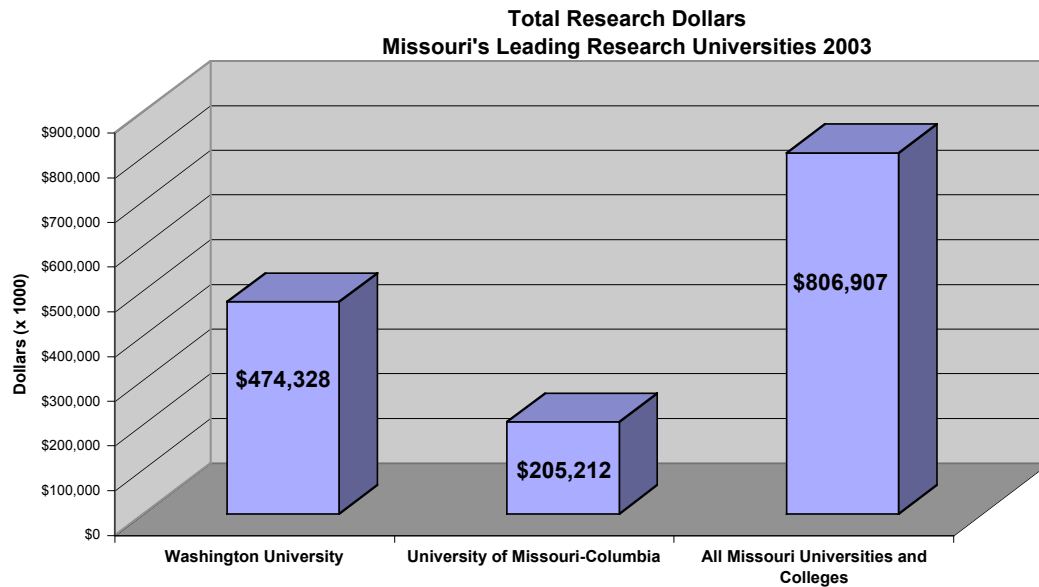
Source: MERIC analysis of O\*NET Online data.

\*Note: Calculated by measuring the percentage of all occupations in which math or science skills were scored at '3' or higher on a 1-5 point scale of importance.



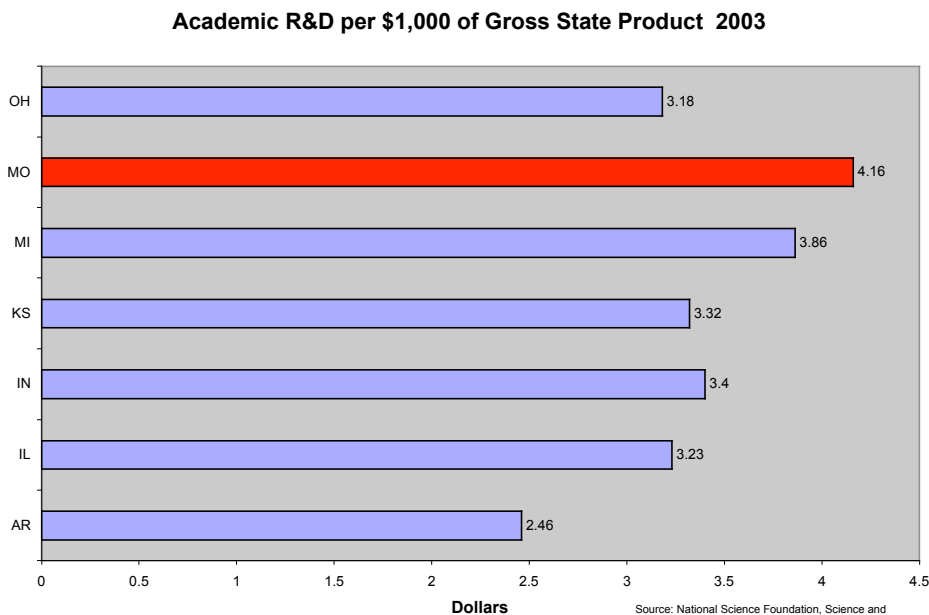
## Inflows of R&D Investment Dollars

Missouri's leading research universities attract substantial R&D investment, driving growth in employment and business opportunities.



Source: NSF, Survey of Research and Development Expenditures at Universities and Colleges, 2003

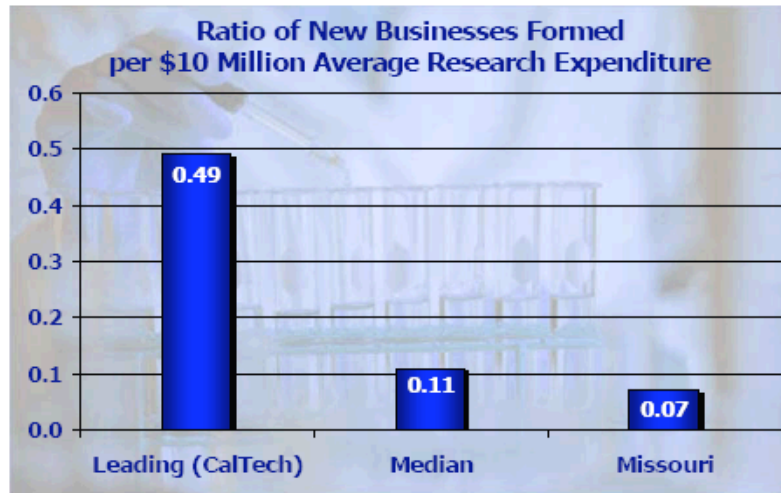
Missouri's academic R&D represents a higher percentage of output than other states.



Source: National Science Foundation, Science and Engineering Indicators 2006

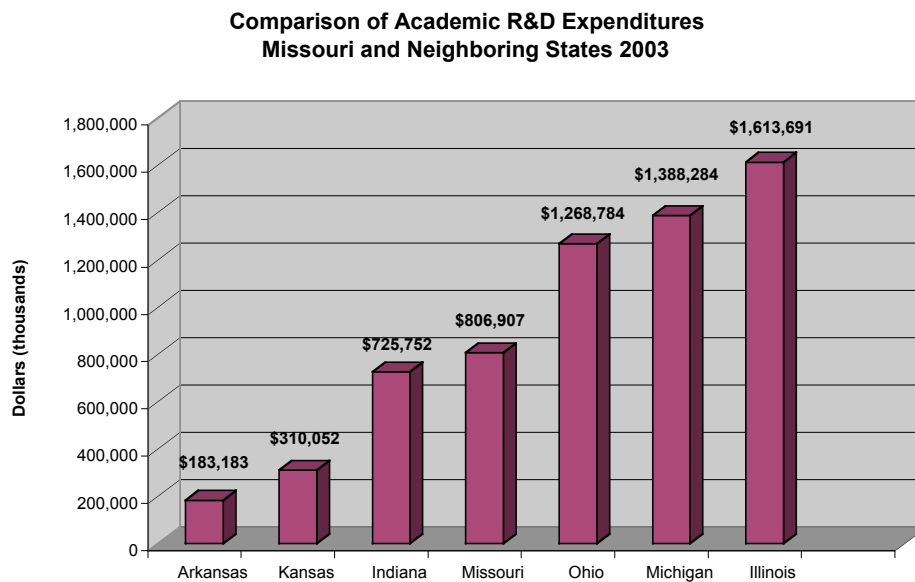
## Inflows of R&D Investment Dollars (cont'd.)

However, this academic R&D is not translated into enough new businesses.



Source: *The Chronicle of Higher Education* using Association of University Technology Managers data from 1996-2000.

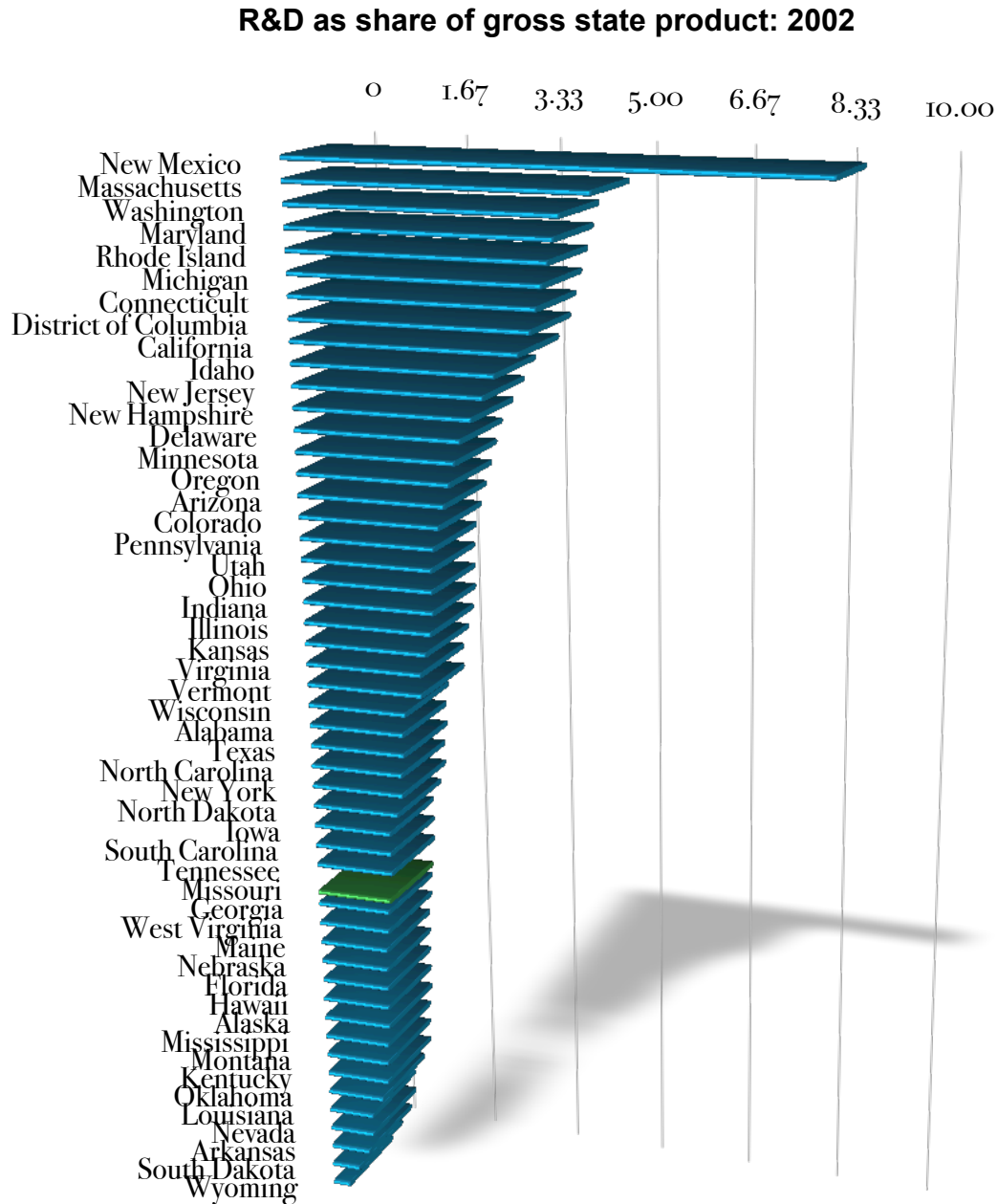
Additionally, the dollar value of Missouri's research enterprise is not as large as that of many neighboring states.



Source: NSF, Survey of Research and Development Expenditures at Universities and Colleges, 2003

## Inflows of R&D Investment Dollars (cont'd.)

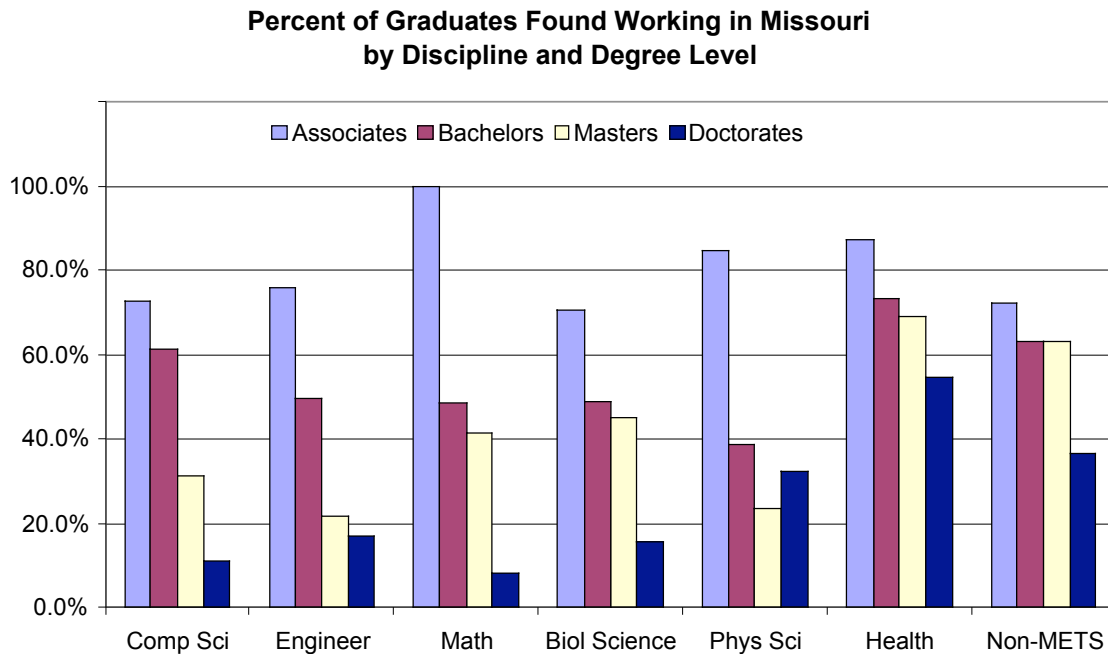
Despite large increases in total R&D expenditures, Missouri is still not as R&D-intensive as other states.



Source: National Science Foundation

## Inflows of R&D Investment Dollars (cont'd.)

A significant share of Missouri's highly educated METS workforce leaves the state.



Source: DHE Administrative records (EMSAS) and DOLIR Wage Records (Quarter 2, 2005)  
Physical Sciences include CIP codes 40 and 41; Engineering includes CIP codes 14 and 15

## Why METS Matters for Missouri: The Bottom Line

- Missouri's strongest and highest-potential economic sectors are at the cutting edge of science and technology.
- Career opportunities and earnings of Missourians who have METS skills are significantly greater than those who do not.
- Math skills matter in half of all the occupations, while science skills matter in one-quarter of all occupations.
- Missouri's research enterprise is not as large as a number of its neighbors.
- The state is not capitalizing sufficiently on its research strengths to produce high-value products and services.

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## II. Where Missouri Stands

### K-12 INDICATORS

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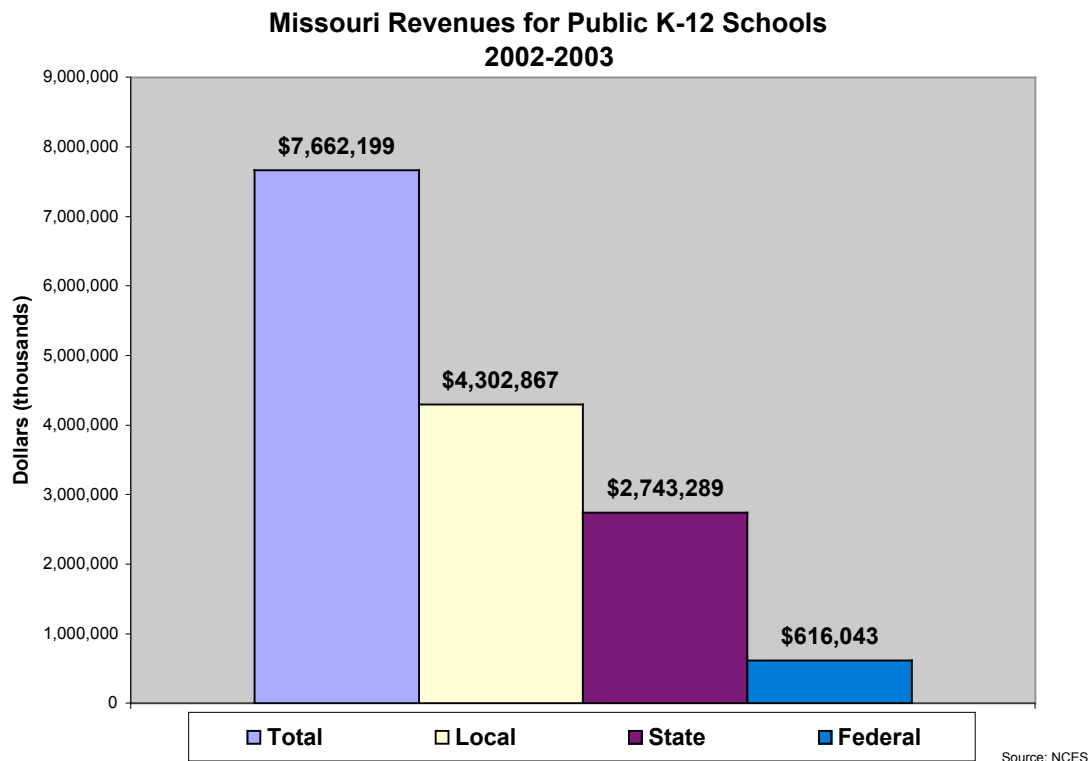
Math and science education in Missouri's \$7.7 billion K-12 enterprise is shaped by the interplay of federal, state, and local authorities. The federal No Child Left Behind Act has set a national goal of proficiency in core subjects by 2014 and holds every school accountable for sufficient yearly progress of all students. Federally mandated math assessments have been part of NCLB since 2002 and will be extended to science in 2007. The Missouri State Board of Education, through the Commissioner and Department of Elementary and Secondary Education, sets standards, establishes course requirements, and administers assessments of student achievement. The state's 524 school districts exercise local autonomy in selecting curriculum materials and hiring teachers.

This complex K-12 system produces a mountain of data, and a wide range of benchmarks that can be used to measure performance. For example, available data make it possible to compare the math achievement of an 8th grader with counterparts across the state, around the country, or in other parts of the world – as well as by gender, income, and race or ethnic background. Selective comparisons can brighten or darken a picture, and only make sense in context. The indicators in this section focus on whether Missouri is on track to equip sufficient numbers of students with the skills to produce a globally competitive METS workforce.

## Investment in Education

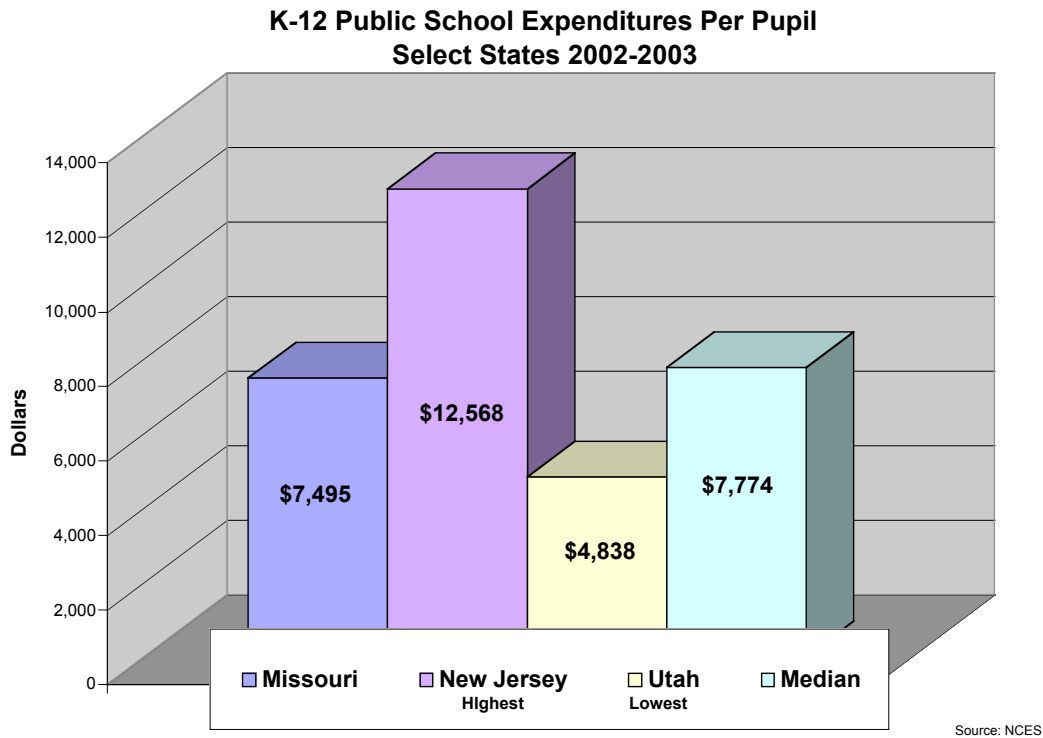
Missouri's \$7.7 billion public K-12 enterprise is vast in scale.

Missouri Public Education Overview 2003-2004	
Total Number of Schools	2,372
Total Students	905,941
Total Teachers	65,169
Total Expenditures	\$7.7 billion
Source: NCES, State Education Data Profiles	

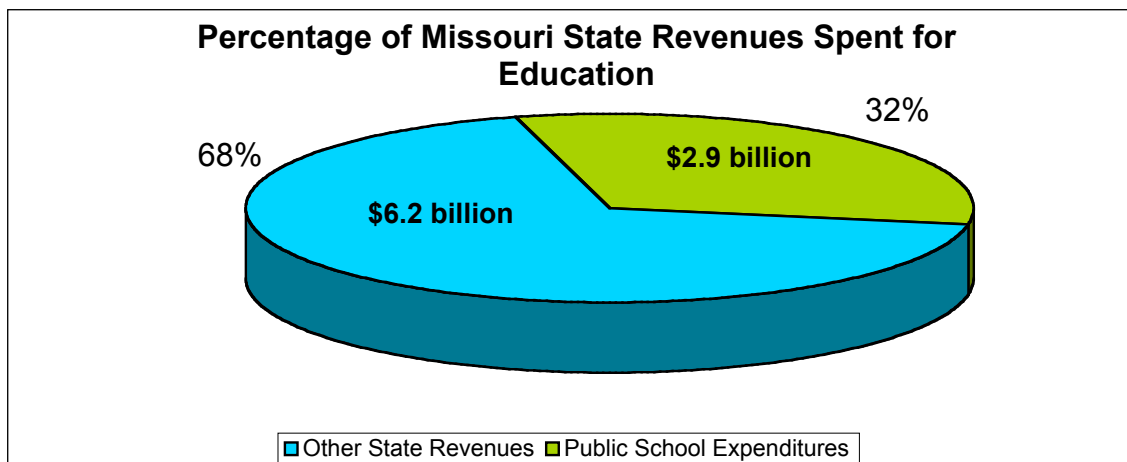


## Investment in Education (cont'd.)

Missouri invests more per student in K-12 education than 22 other states.



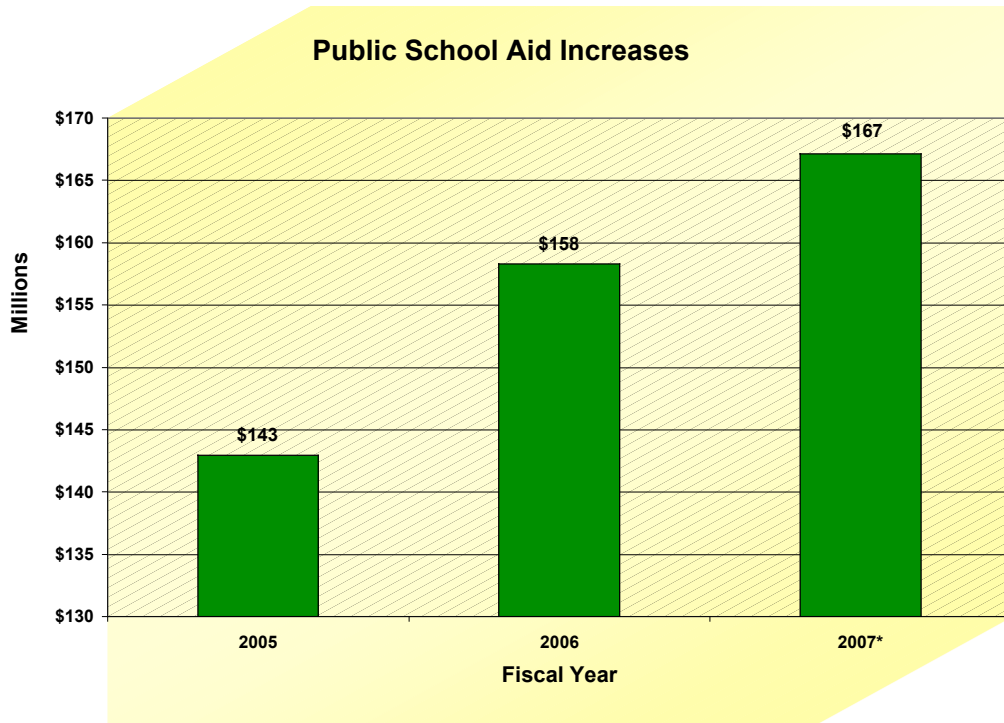
The state has made K-12 education a funding priority.





## Investment in Education (cont'd.)

State funded public school aid is trending upward.



Source: Missouri Office of Administration.

\*Note: FY 2007 is "Governor Recommended," but the final appropriation has not been acted upon by the Missouri General Assembly at time of production.

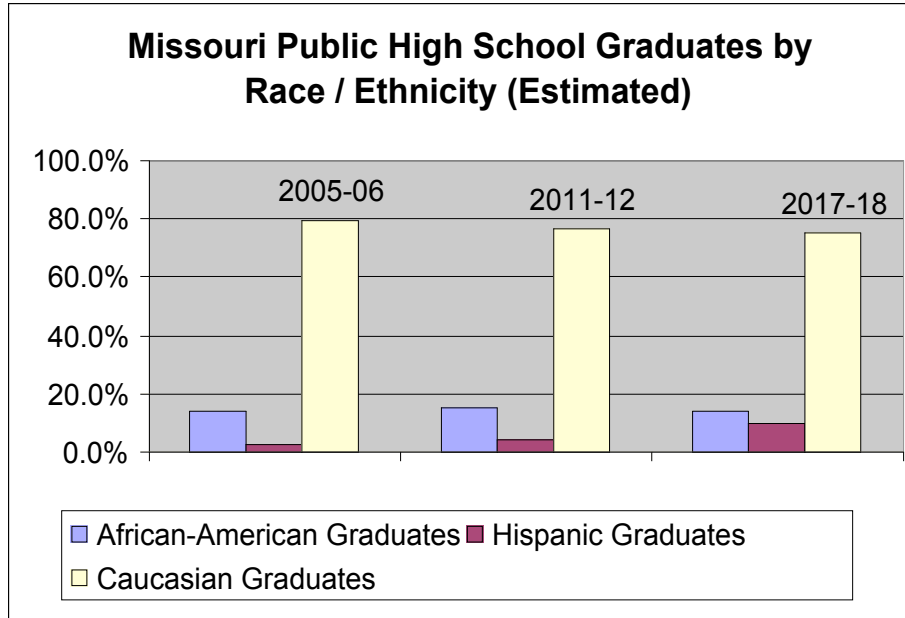
## Demographics

Missouri's student population is diverse, but less so than the nation's as a whole.

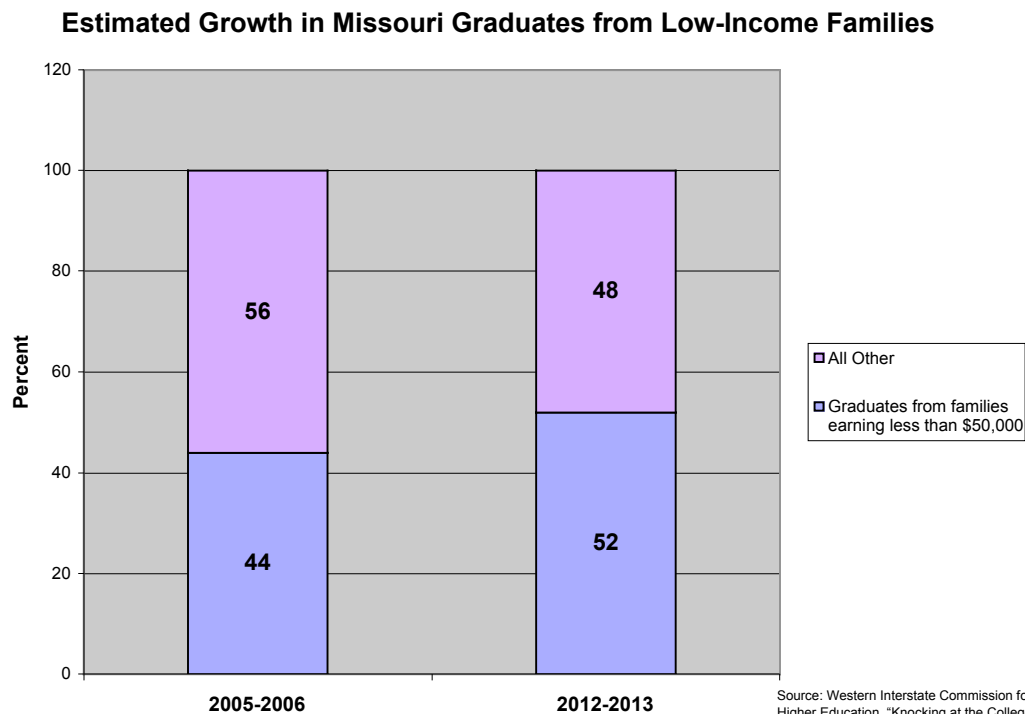
Student Groups		
	Missouri - 2005 (%)	Nation - 2003 (%)
Asian	1.5	4.4
Black	17.8	17.1
Hispanic	2.8	18.1
American Indian	0.4	1.2
White	77.6	59.2
English Learners	2.1	8.5
Socio-Disadvantaged	41.8	58.5
Students with Disabilities	14.8	13.4
Source: DESE, U.S. Dept. of Education, U.S. Dept. of Agriculture		

## Demographics (cont'd.)

Missouri's K-12 population is expected to remain stable in size, with marginal changes in its demographic composition.



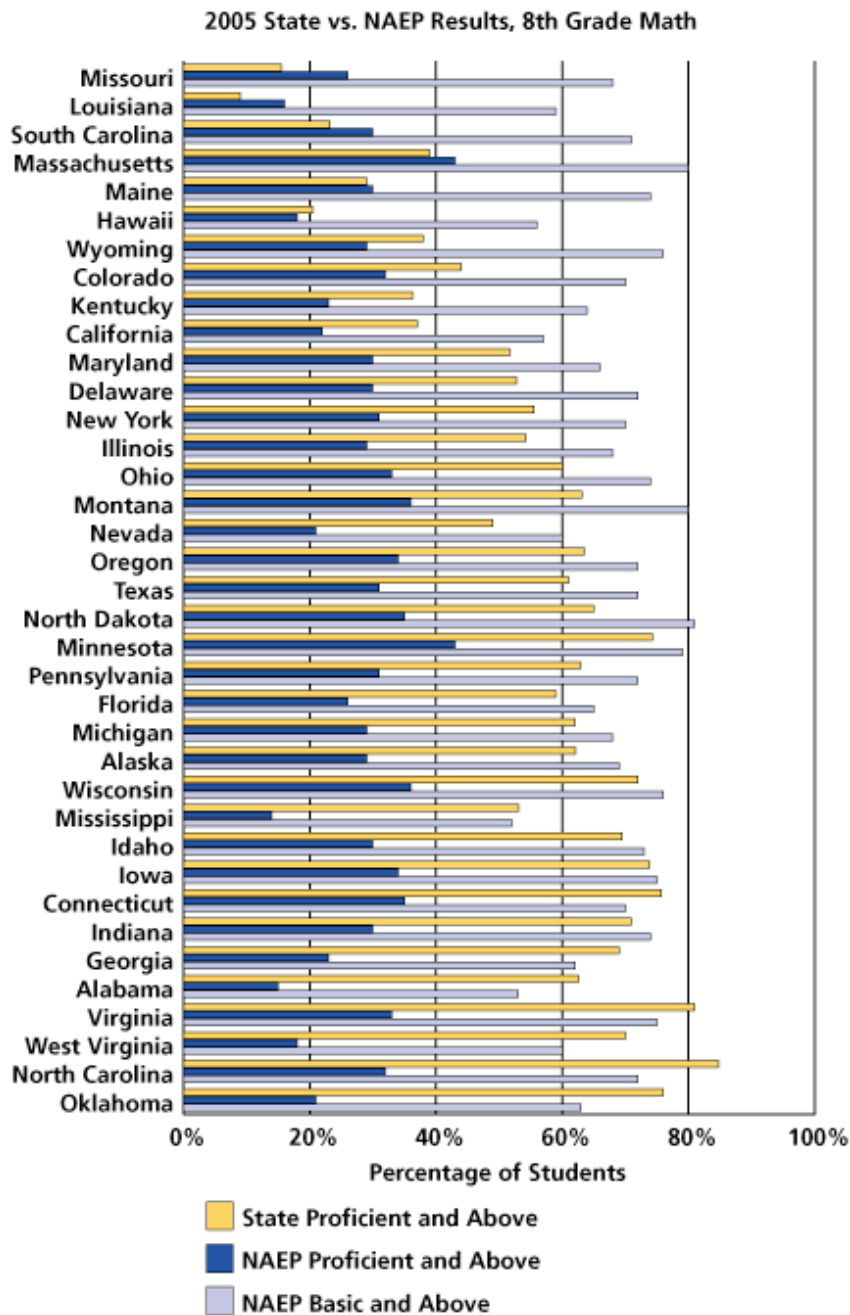
Source: Western Interstate Commission for Higher Education



Source: Western Interstate Commission for Higher Education, "Knocking at the College Door", 2003

## Standards and Assessments

In 2005, Missouri set the bar very high in math assessment relative to national measures of student proficiency.\*



\*Note: This chart shows that a smaller percentage of students were rated proficient (at or above grade level) on Missouri's math assessment than on the National Assessment of Educational Progress. Over the past year, Missouri has lowered its cut scores on state assessments to align more with national measures. Source: NCES.

### *Standards and Assessments (cont'd.)*

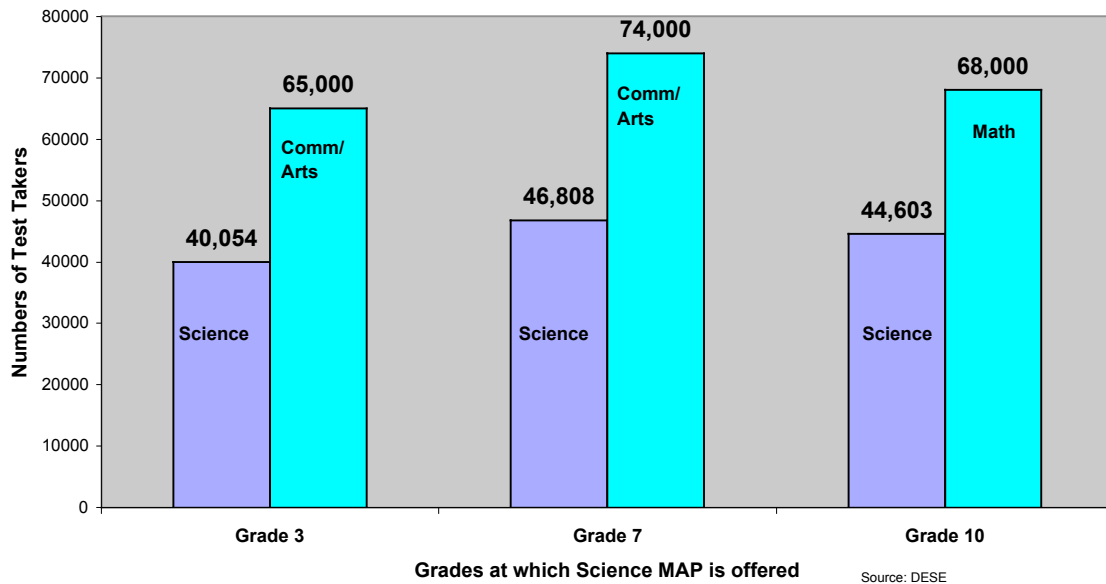
Missouri's minimum high school graduation requirements have been increased to include three years of math and science by 2010.

Minimum State Graduation Requirements		
Subject	2006	2010
Communication Arts	3	3
Mathematics	2	3
Science	2	3
Social Studies	2	3
Fine Arts	1	1
Practical Arts	1	1
Physical Education	1	1
Electives	10	9
Health Education		.5
Personal Finance		.5
Total Minimum Number of Units Required	22	24
Source: DESE.		

## Standards and Assessments (cont'd.)

Some districts do not administer the voluntary science MAP, resulting in lower student participation in Missouri's science assessment than mandatory communications arts and mathematics.\*

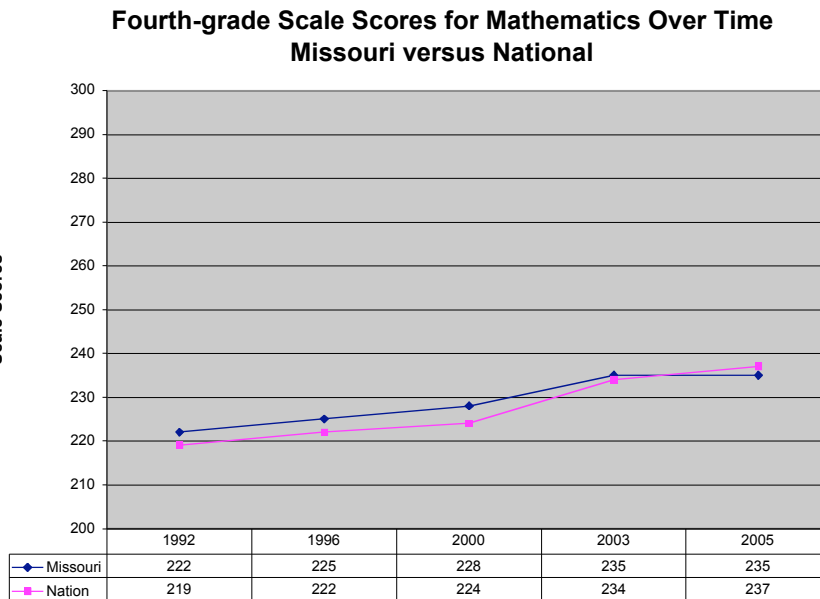
**Missouri MAP Science Test Takers Compared  
to MAP Communication/Arts and Math Test Takers  
2005**



\* Note: Missouri required science assessments from 1999 through 2002. Since then, in the absence of state funding, DESE has made them available and districts have administered them on a voluntary basis at district expense. It is anticipated that federal funding will be available in 2008 to support science assessments that will be required under the No Child Left Behind Act.

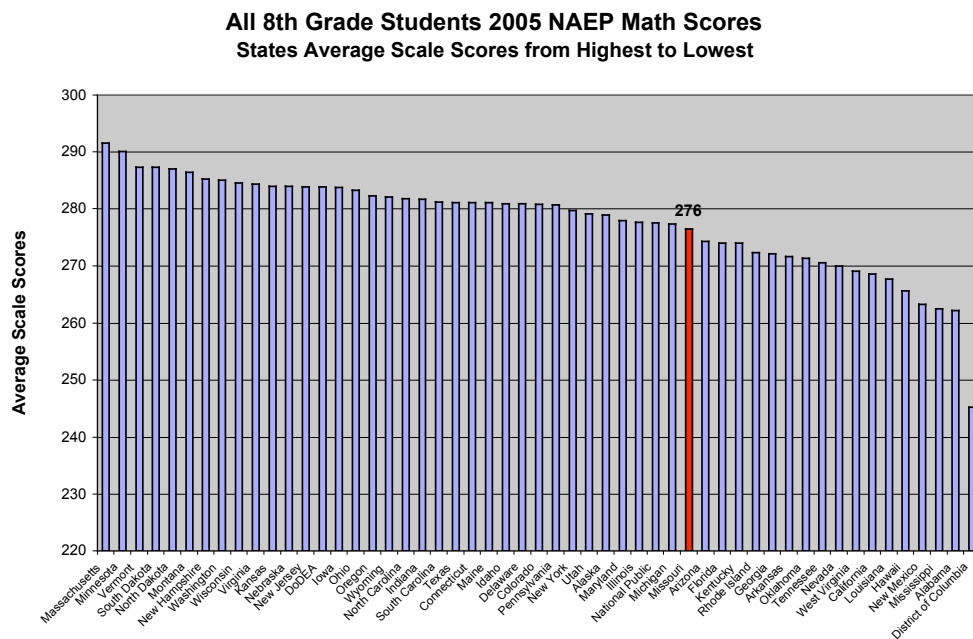
## Student Achievement

Missouri 4th graders have made gains in math since the early 1990s, but rank in the bottom third nationally.



Source: National Center for Educational Statistics

Math scores of eighth graders have declined in national assessments, ranking Missouri below 34 other states.

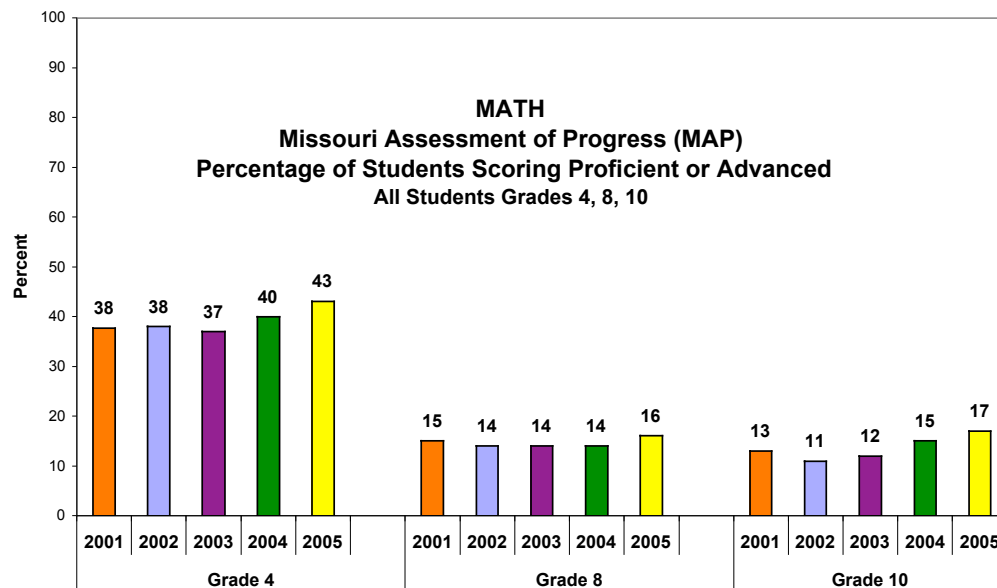


Source: National Center for Educational Statistics



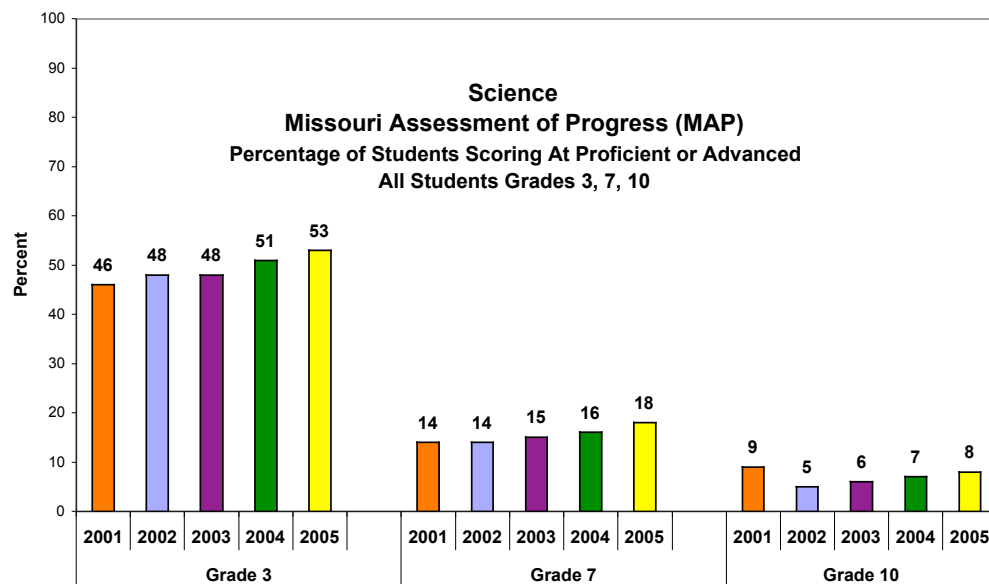
## Student Achievement (cont'd.)

The percentage of students scoring at proficient and advanced levels on the MAP in math and science declines dramatically after fourth grade.



Source: DESE School Accountability Report Card, 2005

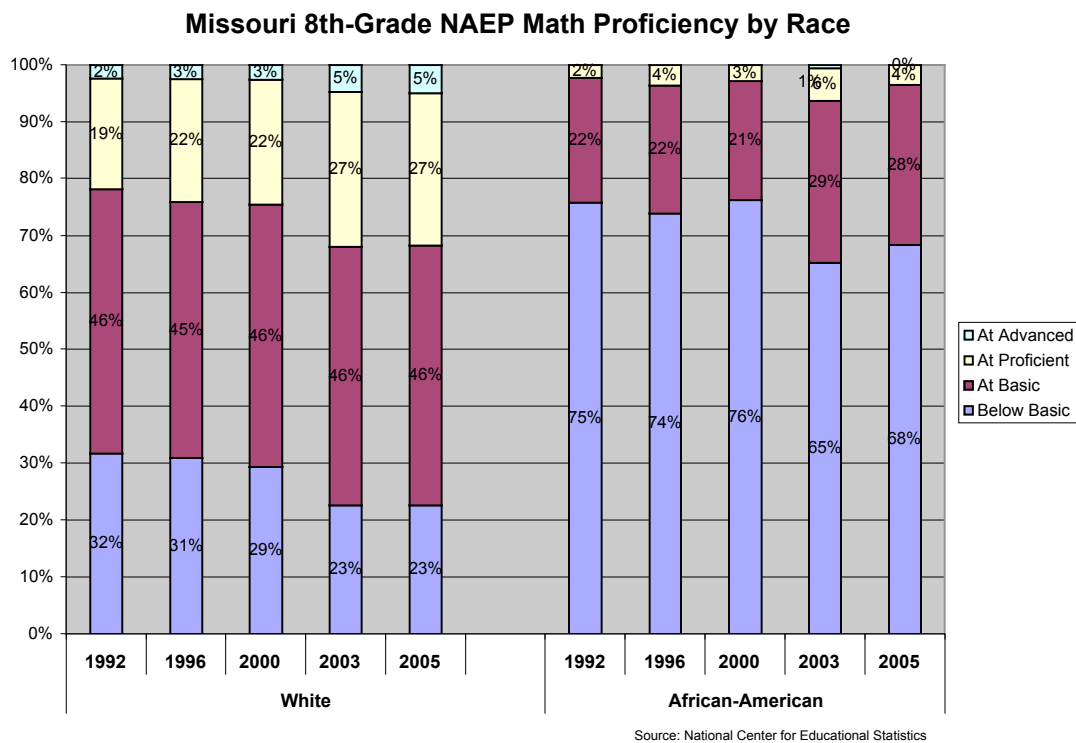
\* Note: Following are the definitions for Advanced: above grade level; Proficient: at grade level; Basic: below grade level, not passing; Below Basic: inadequate .



Source: DESE School Accountability Report Card, 2005

## Student Achievement (cont'd.)

A significant minority achievement gap\* has persisted in Missouri, reflecting national trends.



*\*Note: Sample size for other racial/ethnic groups was too small for NCES to report achievement percentages.*

## Pockets of Excellence

Some of Missouri's top-performing schools\* include significant numbers of low-income and minority students.

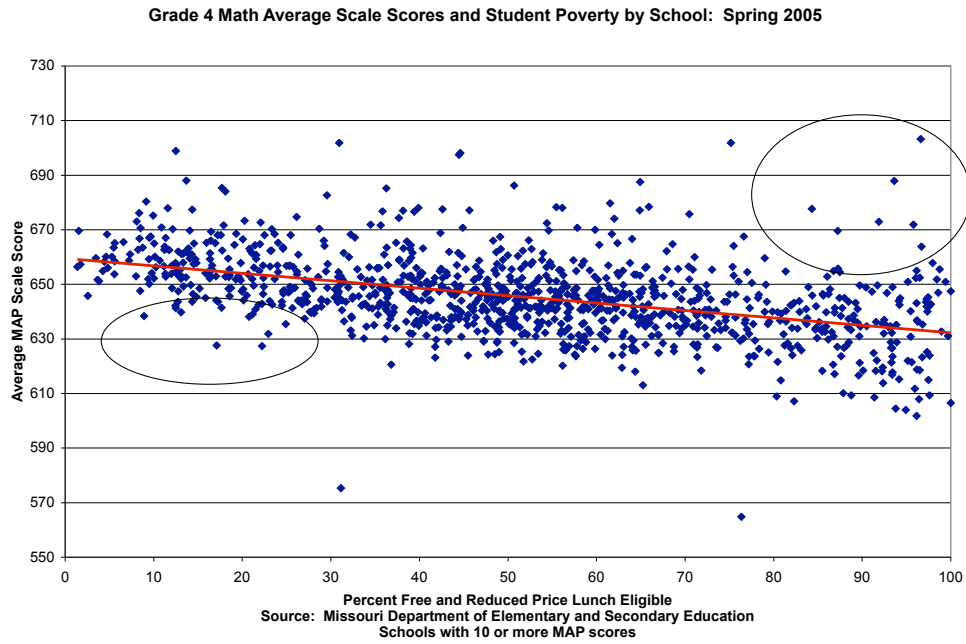
Top Performing Schools Meeting Poverty Threshold †		
School Type	Number	Top Performing Schools (%)
Elementary	5 out of 31	16
Middle Schools	9 out of 31	29
High Schools	7 out of 33	21
† Poverty Threshold = percent of students receiving free or reduced lunch above the state average (41.8%).		

Top Performing Schools Meeting Minority Threshold ‡		
School Type	Number	Top Performing Schools (%)
Elementary	5 out of 31	16
Middle Schools	9 out of 31	29
High Schools	7 out of 33	21
‡ Minority Threshold = percent of minority enrollment above the state average (22.6%).		

\*Note: Top Performing Schools refer to the top ten schools with the highest percentage of students performing at the proficient and advanced levels on the MAP. Data Source: Missouri Department of Elementary and Secondary Education – MAP Highest Performing Report 2000 to 2005 – test grades 4, 8 and 10.

## Pockets of Excellence (cont'd.)

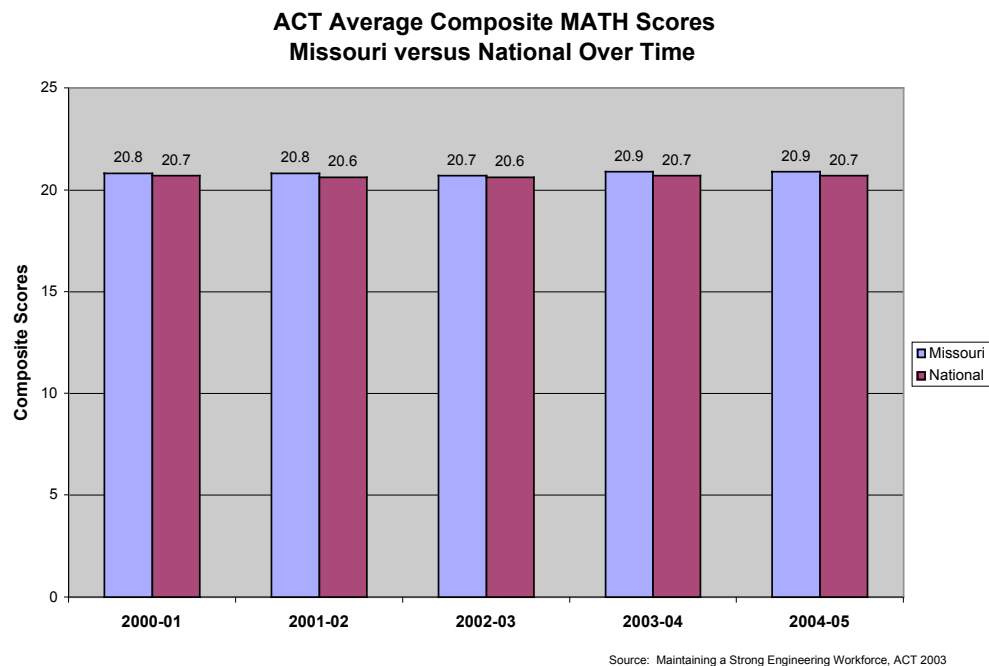
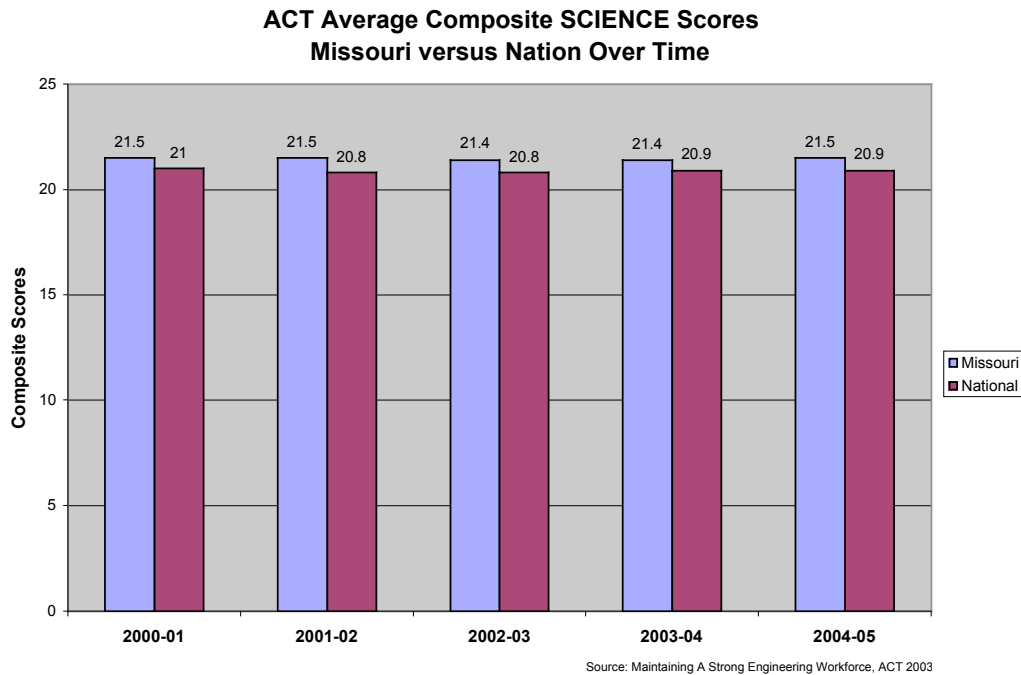
Some high-poverty schools are high performing.\*



\* Note: The circled high-poverty schools in the upper right are scoring a lot higher than the circled low-poverty schools on the lower left.

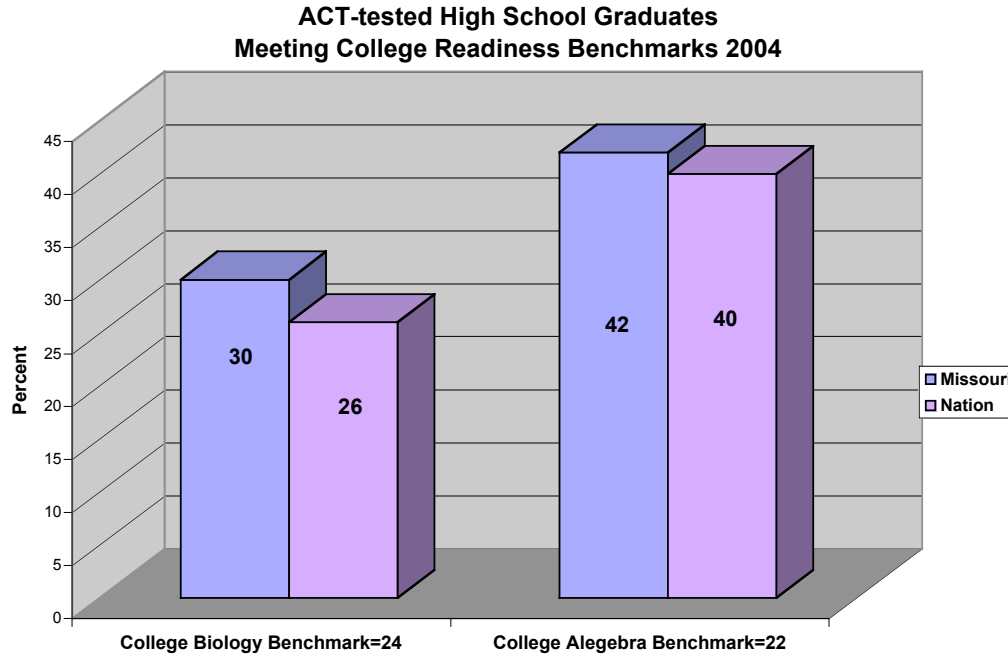
## Post-secondary Preparation

Seventy percent of Missouri's high school graduates take the ACT, with math and science scores slightly above the national average.

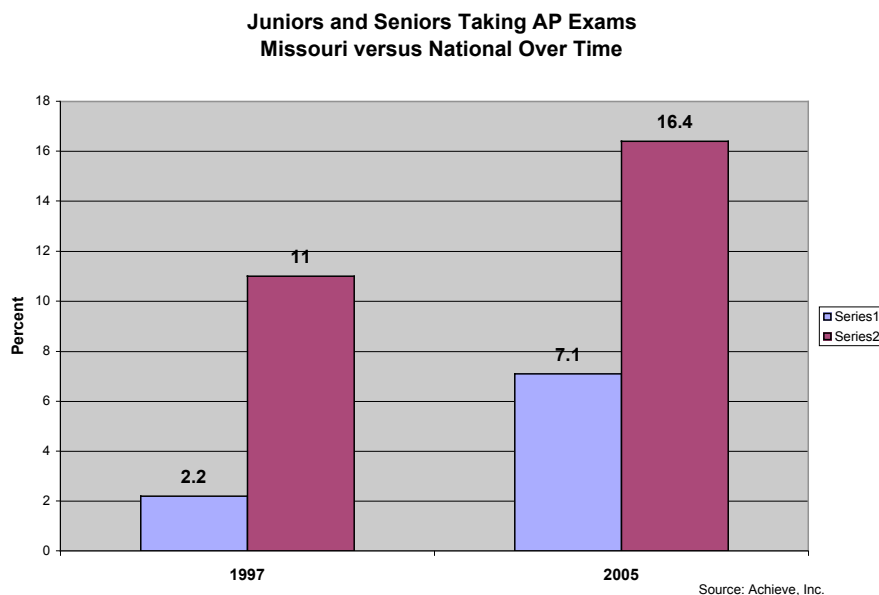


## Post-secondary preparation (cont'd)

Nevertheless, less than half of Missouri high school students meet ACT college-readiness benchmarks in biology and algebra.



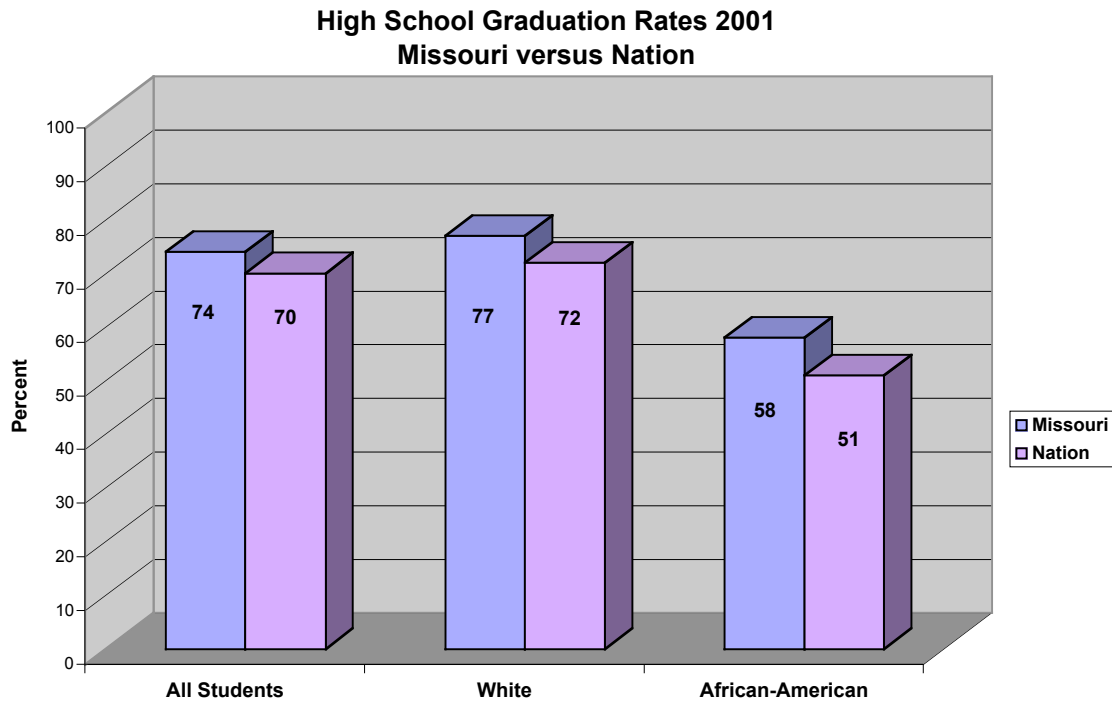
Missouri 11th and 12th graders lag the national average in taking advanced placement mathematics.\*



\*Note: Missouri's dual-credit system that allows some students to take college-level courses reduces participation in AP.

### Post-secondary preparation (cont'd)

On-time graduation is better than the rest of the country, but there is still a great loss of talent, especially among minority groups.

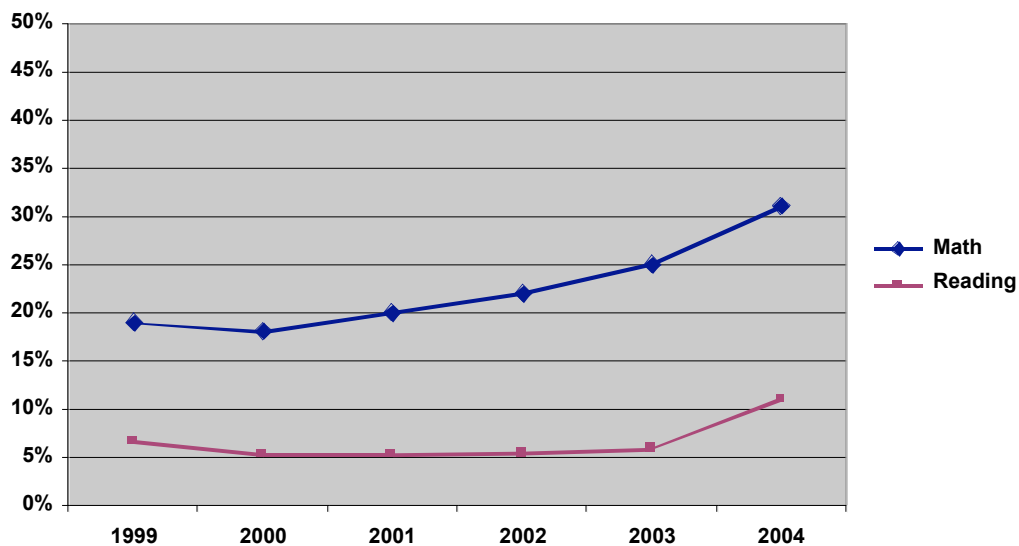


Source: Edtrust, Education Watch, Spring 2004

## Post-secondary preparation (cont'd)

Missouri has seen a steady increase in the percentage of first-time freshmen enrolled in remedial math courses and, more recently, in remedial reading.

Percentage of First-time Freshman Enrolled in Remedial Classes at Missouri Public Institutions



Source: MERIC analysis of Missouri Dept. of Higher Education, EMAS Data.

## Where K-12 Stands: The Bottom Line

- Despite notable pockets of excellence, Missouri is not providing enough students with foundational math and science skills.
- The percentage of students rated proficient in math and science declines dramatically beyond 4th grade.
- The minority achievement gap has closed slightly, but remains wide.
- Although Missouri students score above the national average, less than half meet pre-college ACT benchmarks in algebra and biology.
- The need for post-secondary remediation in math has increased significantly in recent years.



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# Where Missouri Stands

## THE K-12 TEACHER CORPS

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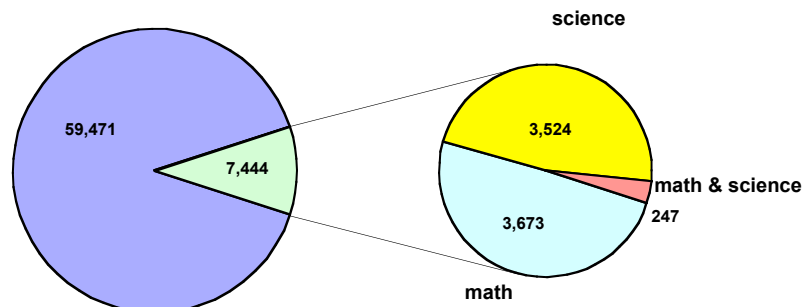


Missouri's teaching force stands out as an important leverage point in building capacity in METS. Research has shown that a skilled teacher can make a decisive difference in the achievement of students from all backgrounds in math and science. Missouri's elementary school teachers are expected to provide the basics in all core subjects. The state's middle and high school teachers draw upon more specialized knowledge to deliver more challenging material. Missouri's colleges of education train and certify most pre-service teachers and also provide in-service professional development. The demand for math and science teachers is largely determined by changes in student population, career attractiveness, and rates of retirement. The indicators in this section focus upon the forces shaping the supply, retention, and distribution of skilled math and science teachers across the state.

## Size, Demographics and Qualifications

Missouri's corps of middle and high school math and science teachers is large.

**Missouri's Middle, Junior, and High School Math & Science Teachers  
Relative to All Teachers and by Area of Specialization  
2004-2005**



Source: DESE  
Administrative Records  
(Core Data), 2005

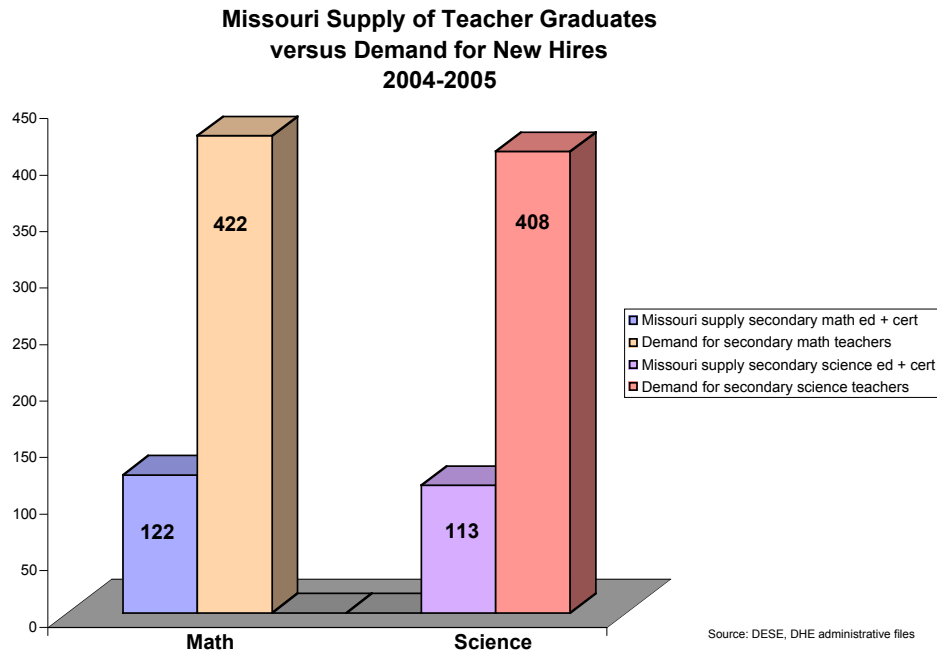
## Size, Demographics and Qualifications (cont'd.)

Teaching math and science requires specialized knowledge.

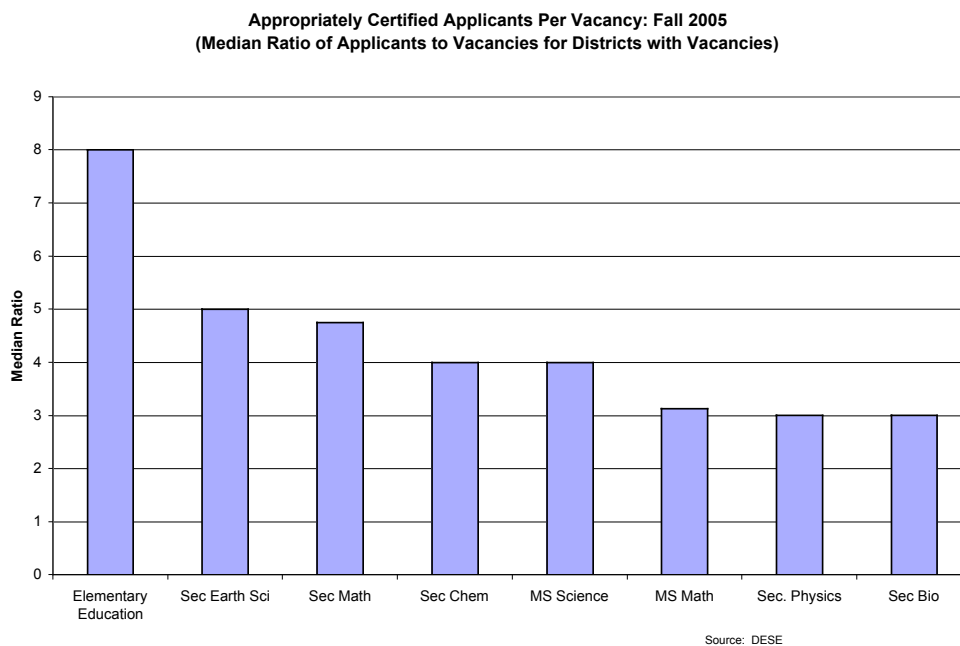
Requirements for Math and Science Teaching Licenses in Missouri				
	Elementary Certification	Middle School Certification	High School Certification	Temporary Authorization Certification
Education	BA from approved teacher education program	BA from approved teacher education program	BA from approved teacher education program	BA in a subject area or closely aligned field
Professional Requirements	60 hours professional education	53 hours professional education	26 hours of professional education	24 hours professional education
GPA	Minimum 2.5 overall and in teaching area	Minimum 2.5 overall in teaching area	Minimum 2.5 overall and in teaching area	Minimum 2.5 overall in teaching area
Content Knowledge	Qualifying score on Praxis II test in elementary education	Qualifying scores on Praxis II test in subject area	Qualifying scores on Praxis II test in subject area	Qualifying scores on Praxis II test in subject area and pedagogy
Subject Matter Hours	Five semester hours in math and eight semester hours in reading	21 semester hours	Mathematics: 30  Biology, Chemistry, Physics: 32  Unified Science: 59	High school: 30  Middle school: 20
Clinical Experience	10 semester hours	10 semester hours	10 semester hours	Three years on-the-job experience
Source: DESE, Missouri Educator Certificate Requirements, available at <a href="http://www.dese.mo.gov">www.dese.mo.gov</a> .				

## Supply

Pre-service METS teacher production does not meet demand.



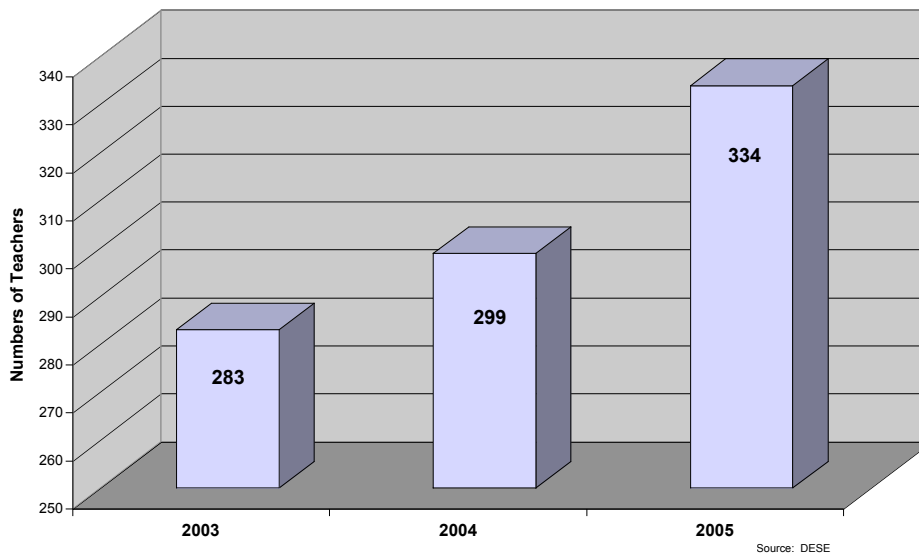
There are roughly twice as many certified applicants per vacancy in elementary education as there are in math and science.



## Supply (cont'd.)

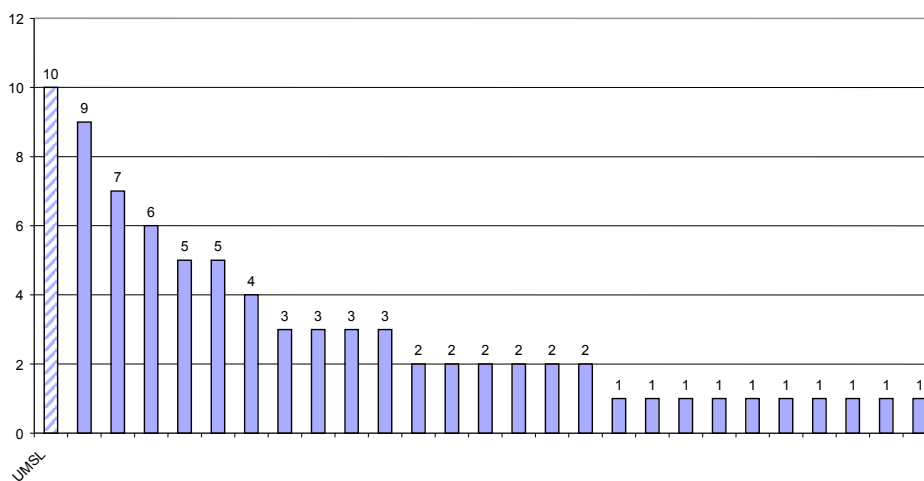
Therefore, local districts have increasingly relied on less experienced teachers.

**Missouri Math and Science Teachers  
with Temporary Authorization Certification 2003-2005**



Pre-service degree production in biology is widely distributed among Missouri's 37 teacher education programs.\*

**New Teachers Recommended for Certification by Institution:  
Secondary Biology, 2005**



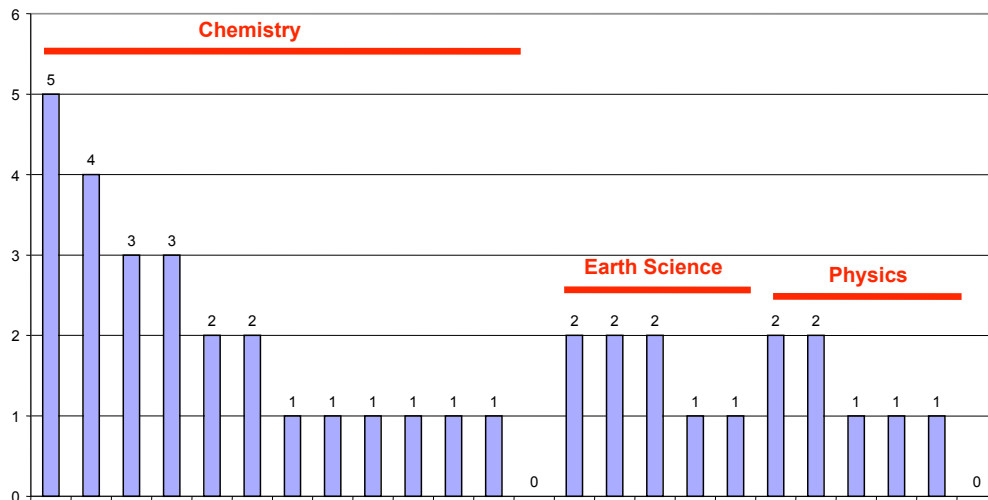
Source: Missouri Department of Elementary and Secondary Education. Schools with fewer than 10 candidates not identified

\*Note: Teacher preparation programs producing less than 10 teachers are not listed by name.

## Supply (cont'd.)

Most Missouri teacher preparation programs produced three or fewer physical sciences teachers in 2005.

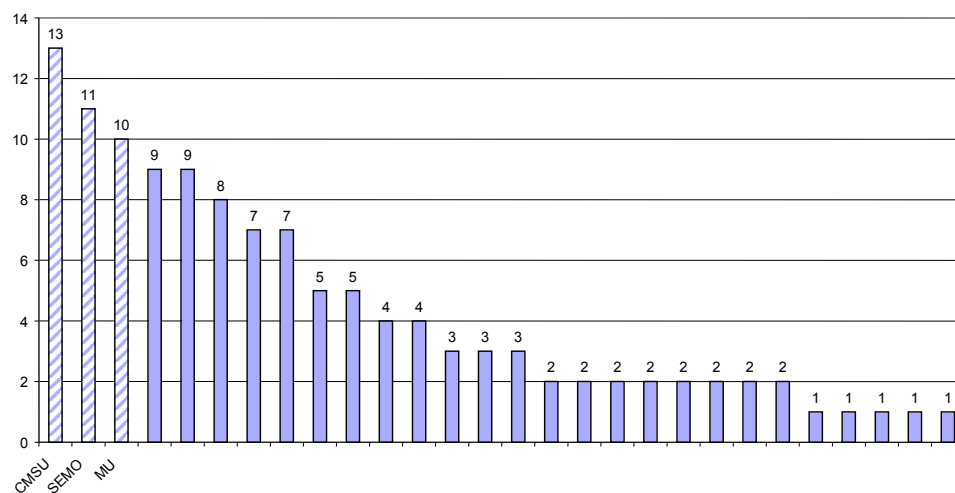
**New Teachers Recommended for Certification by Institution:  
Physical Sciences, 2005**



Source: Missouri Department of Elementary and Secondary Education. Schools with fewer than 10 candidates not identified

Only three teacher preparation programs produced 10 or more secondary math teachers in 2005.

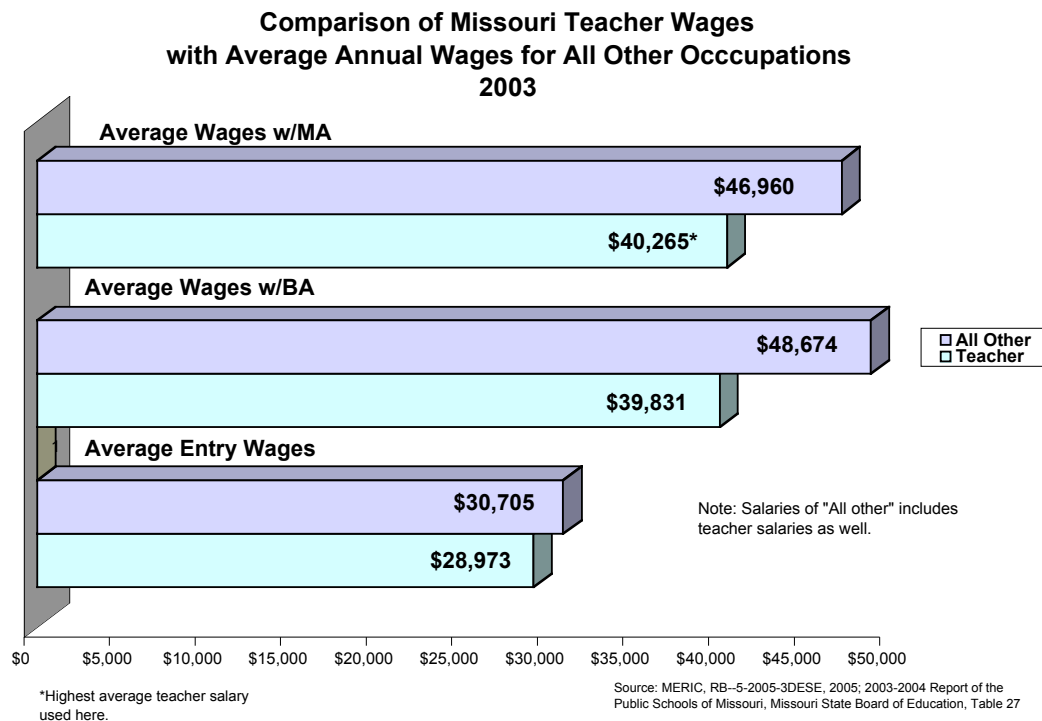
**New Teachers Recommended for Certification by Institution:  
Secondary Math, 2005**



Source: Missouri Department of Elementary and Secondary Education. Schools with fewer than 10 candidates not identified

## Career Attractiveness

Teachers earn less than their counterparts in other occupations with comparable qualifications and experience.\*

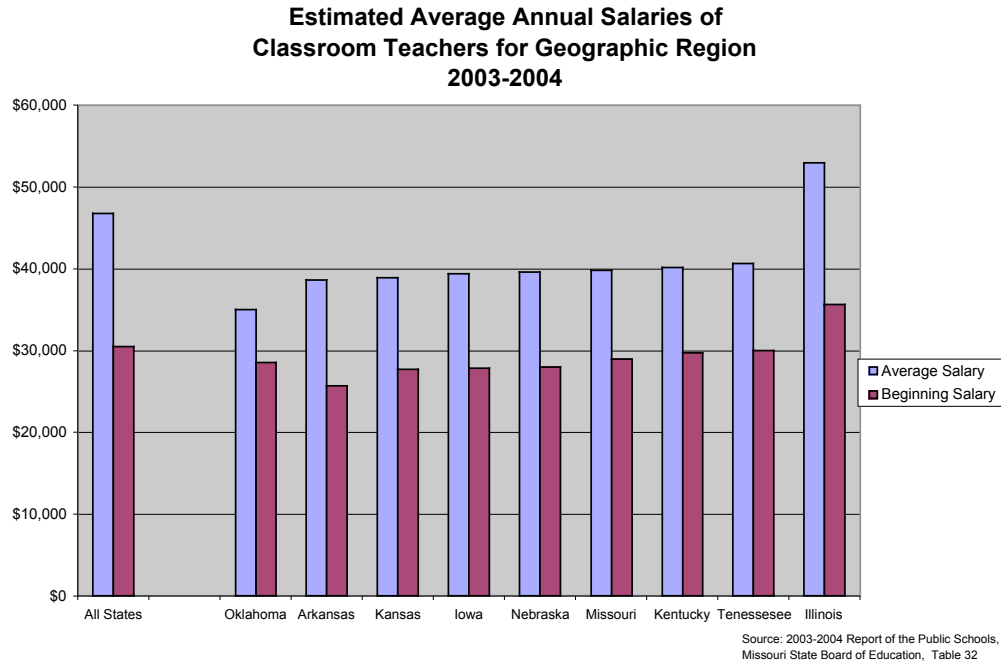


*\*Note: BA degree holders are paid more than Masters' degree holders because the former category includes many computer, financial and managerial positions while the latter category includes large numbers of such relatively low paying occupations as social workers, counselors, and librarians.*

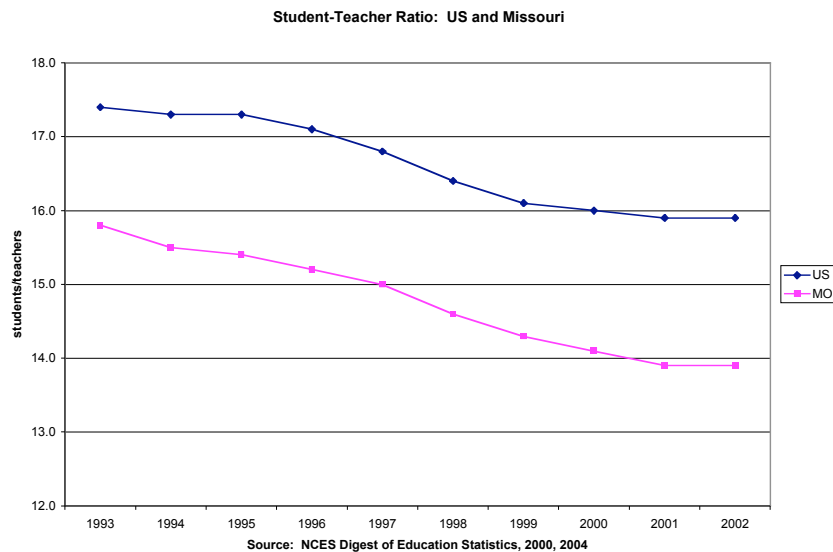
*Also: Teacher's salaries are based on the teaching year rather than 12 months.*

## Career Attractiveness (cont'd.)

Missouri's teachers are paid about the same as many of their counterparts in neighboring states, but less than the national average.



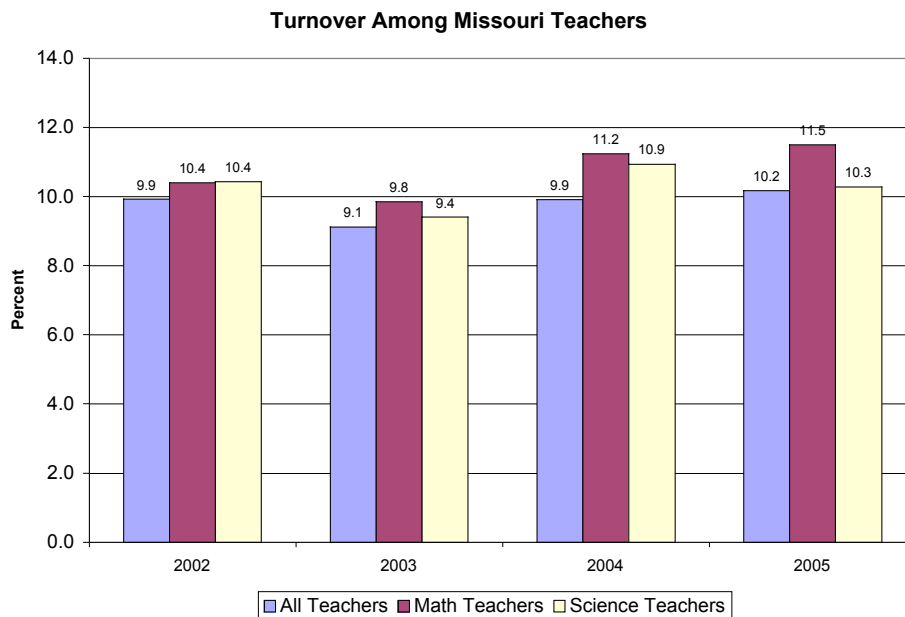
Missouri appears to have made the hiring of more teachers per student a higher priority than increasing the pay of the existing teacher force.





## Career Attractiveness (cont'd.)

The turnover rate of math and science teachers is slightly higher than that of all teachers.

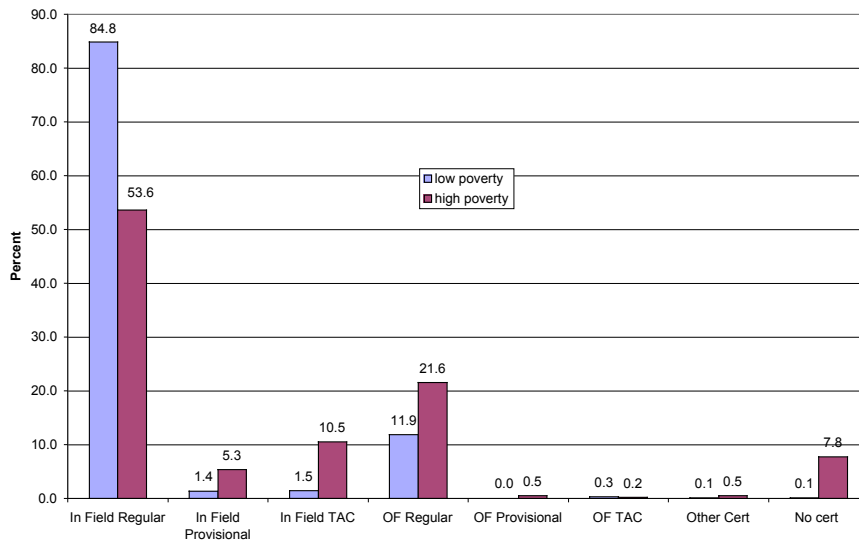


Source: DESE.

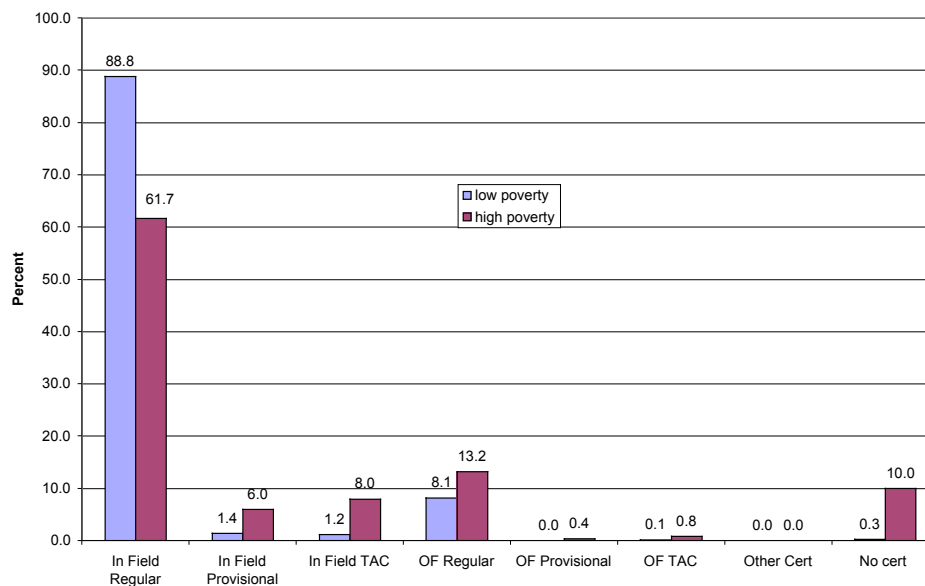
## Distribution

Missouri's high poverty districts are underserved by certified math and science teachers.

**Math Certification Rates by District Poverty Rate**



**Science Certification Rates by District Poverty Rate**



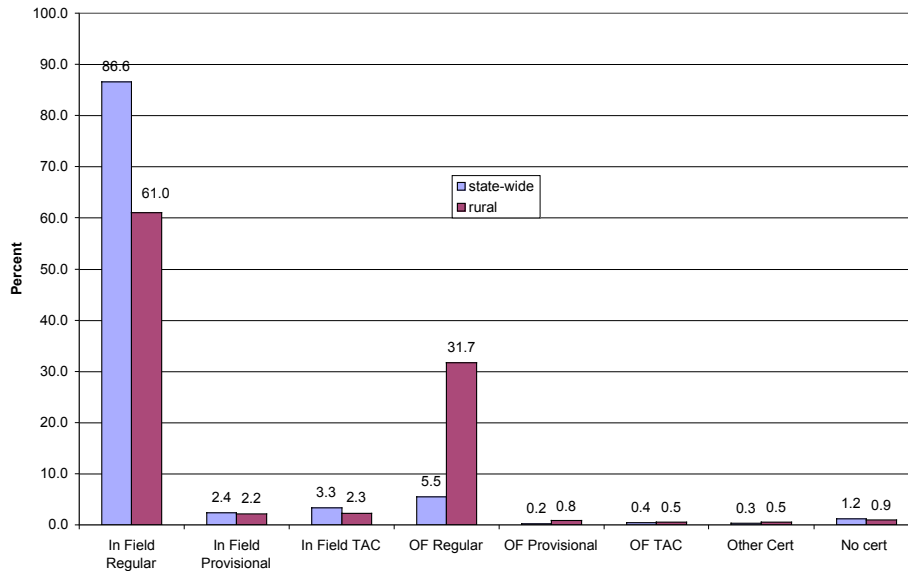
Source for graphs on this page and the next : DESE.

Note: "OF" means out of field, a subject for which one is not licensed. "TAC" means Temporary Authorization Certificate. TAC and Provisional licenses indicate that the holder is lacking either experience, coursework, or completion of a test required for full licensing.

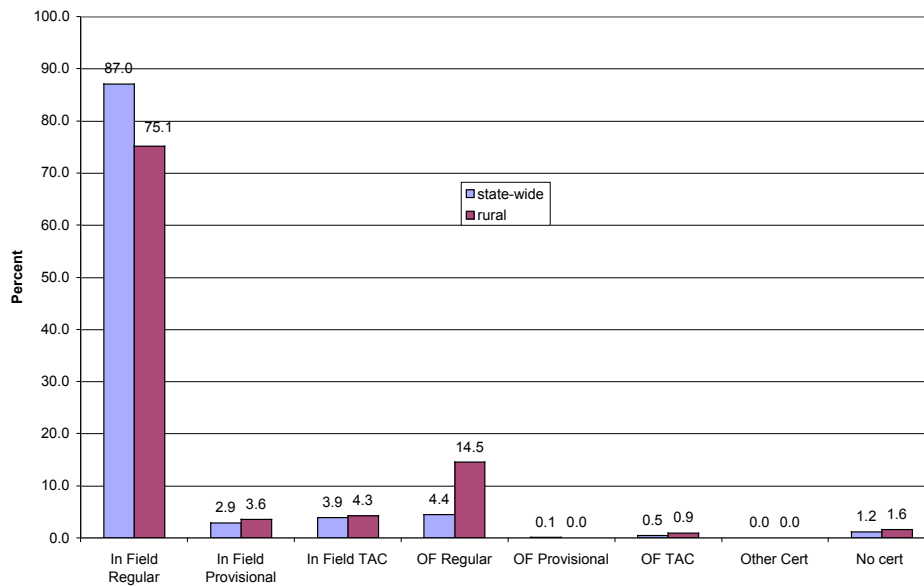
## Distribution (cont'd.)

Rural school districts are also underserved.\*

**Math Certification Rates by Rural Status**



**Science Certification Rates by Rural Status**



*\*Note: Key service providers of online math and science K-12 courses include the Missouri Interactive Telecommunications-Education Networks, Missouri Virtual School, and the University of Missouri Columbia High School.*

# Professional Development

Missouri offers diverse professional development opportunities for math and science teachers, but lacks an integrated statewide effort.

## **DESE**

Sponsors conferences, workshops, and academies at the district, regional, and state levels with special focus on school improvement in math and science.

## **Coordinating Board of Higher Education**

Administers competitive grant program in math and science for higher education/high-need school district partnerships.

## **National Science Foundation Math-Science Partnerships**

Funds professional development through university-based centers of excellence and non-profit organizations.

## **Regional Professional Development Centers:**

Facilitate math and science professional development.

## **School Districts**

Larger districts fund math and science curriculum supervisors and instructional support staff.

## **Science Teachers of Missouri and the Missouri Council of Teachers of Mathematics**

Host annual conferences for K-16 teachers.

## **Private Foundations**

Provide targeted grants.

## Where the K-12 Teacher Corps Stands: The Bottom Line

- The supply of certified pre-service math and science teachers is widely dispersed and does not meet demand.
- Rural and low-income districts are underserved by math and science teachers with prescribed content knowledge and experience.
- Missouri appears to have placed more emphasis on reducing the student-teacher ratio than increasing teacher salaries.
- Wide-ranging opportunities are available for in-service professional development, but the state lacks a coordinated approach.

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# Where Missouri Stands

## HIGHER EDUCATION

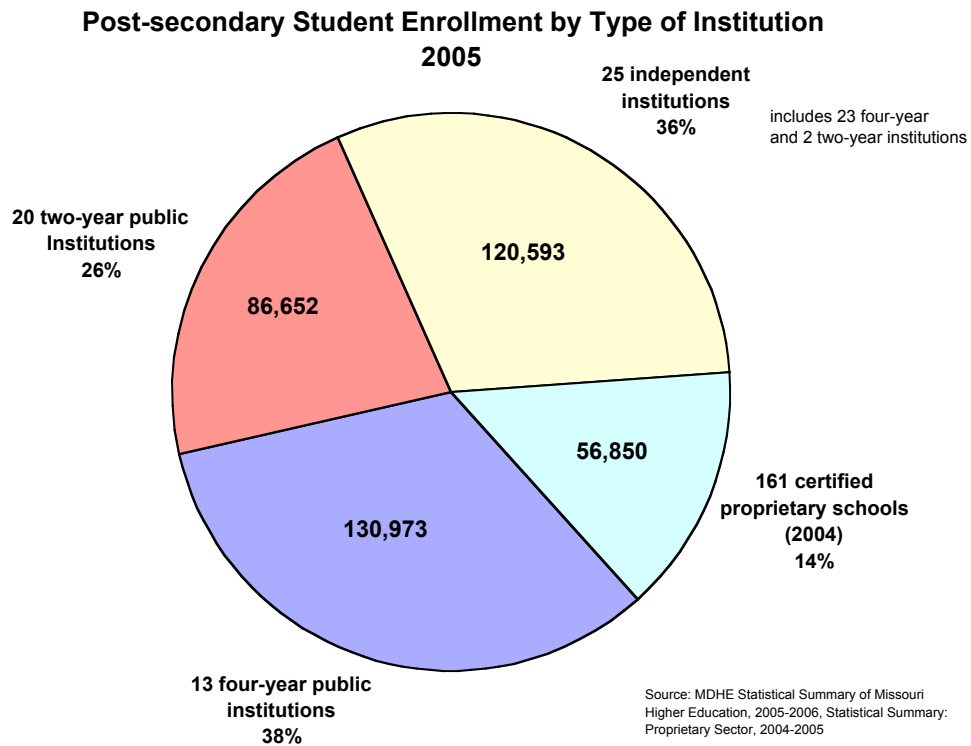
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Missouri's institutions of higher education provide the bridge between the K-12 system and the METS workplace. They develop both the human and intellectual capital that drives the economy of the state. The higher education enterprise includes 36 four-year campuses, 22 two-year campuses, and 161 proprietary schools enrolling a student population of almost 400,000. One of its essential functions is to ensure that all graduates are sufficiently fluent in METS to meet the demands of today's workplace. A second is to produce a specialized talent pool in METS disciplines of the quality and depth needed to underpin Missouri's prosperity. A third is to generate knowledge that can be translated into high-value products and services.

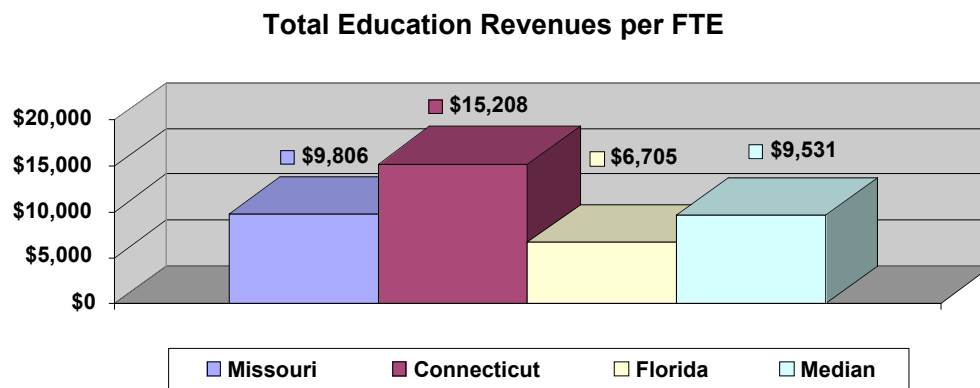
The indicators in this section put into perspective the capacity and performance of Missouri's institutions of higher education in developing METS talent.

Post-secondary students in Missouri have a variety of educational options available to them within the state.



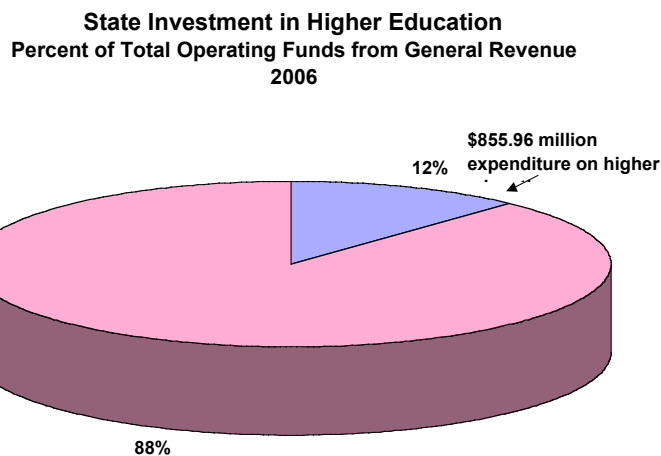
## The State's Investment in Higher Education

Missouri's public higher education ranks 23rd in the nation in available educational resources per full-time equivalent (FTE) student.



Data Source: NCHEMS ([www.Higheredinfo.org](http://www.Higheredinfo.org)), 2005.

The state's investment in higher education accounted for twelve percent of total General Revenue operating funds in 2006.\*



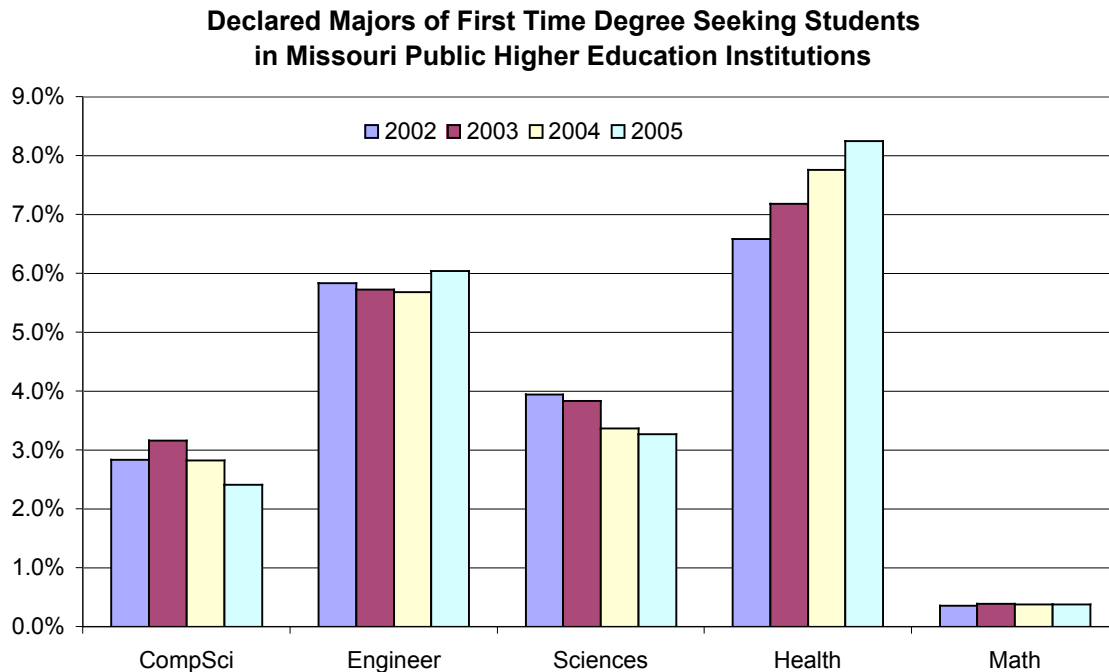
\* Note: This amounts to a 12 percent decrease in state appropriations for two- and four-year institutions between 2002 and 2006, but funding did increase in Governor Blunt's recommended FY 2007 budget.

Source: Missouri Office of Administration.



## Interest and Readiness

The proportion of first-time college students indicating they will major in a METS field is only around 20% – and much less if health fields are not included.

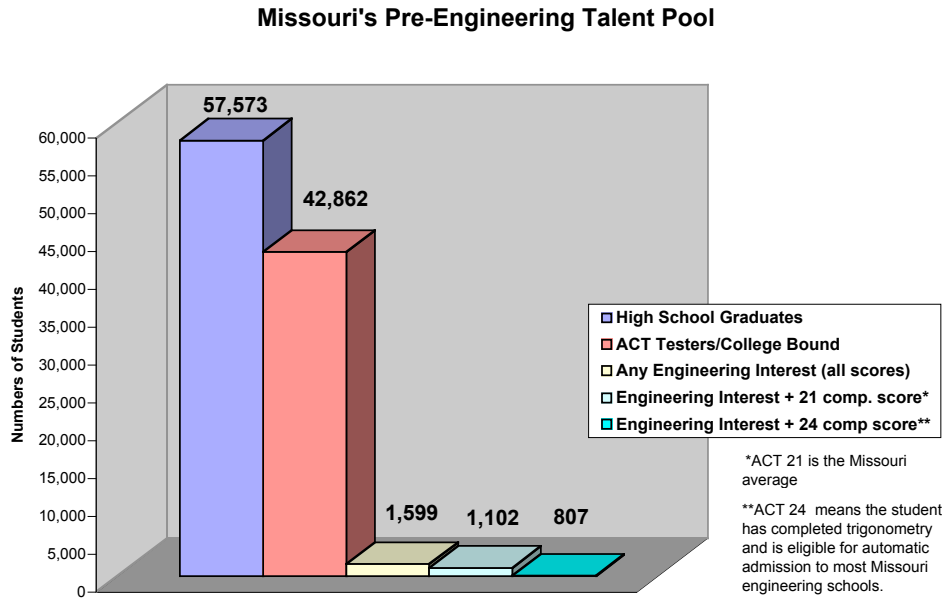


Source: DHE Administrative records (EMSAS)

Sciences include CIP codes 02, 26, 40, and 41; Engineering includes CIP codes 14 and 15

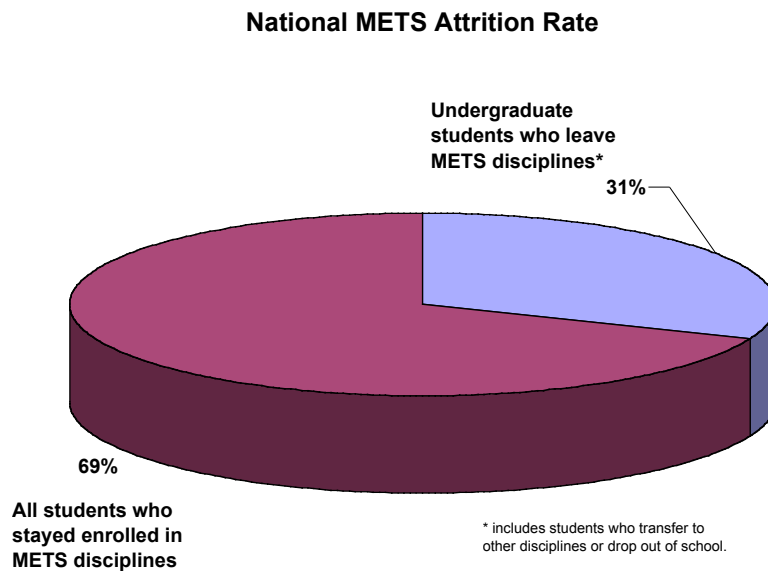
## Interest and Readiness (cont'd.)

Only about five percent of college-bound students in Missouri and nationwide express interest in pursuing an engineering degree.



Source: ACT 2004

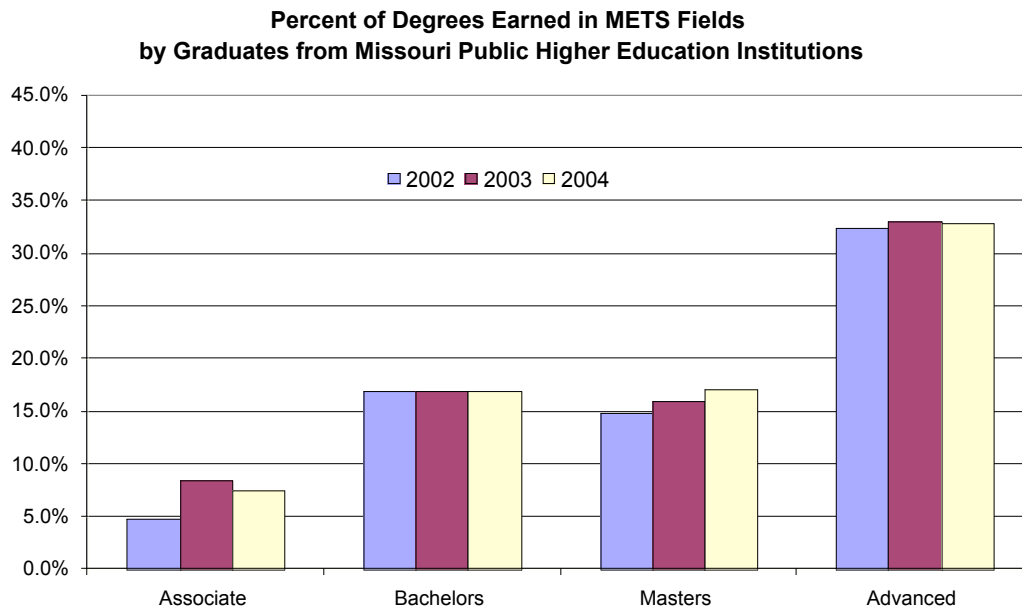
Attrition in METS is high in Missouri and nationwide.



Source: Center for Institutional Data Exchange and Analysis, September 2001

## Degree Production

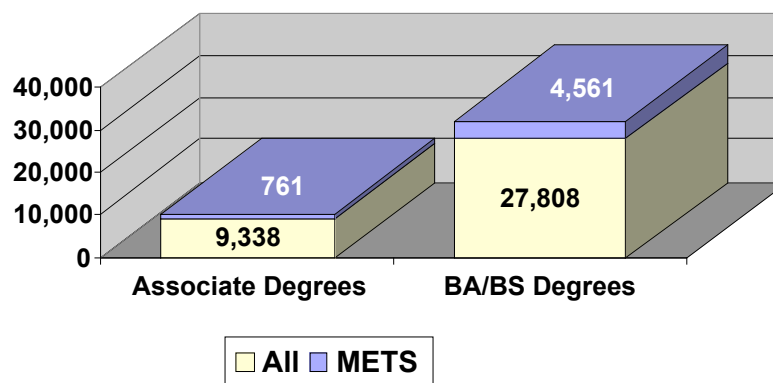
METS represents only a fraction of degrees earned in Missouri's public institutions.



Source: DHE Administrative records (EMSAS)

Sciences include CIP codes 02, 26, 40, and 41; Engineering includes CIP codes 14 and 15 (Health excluded)

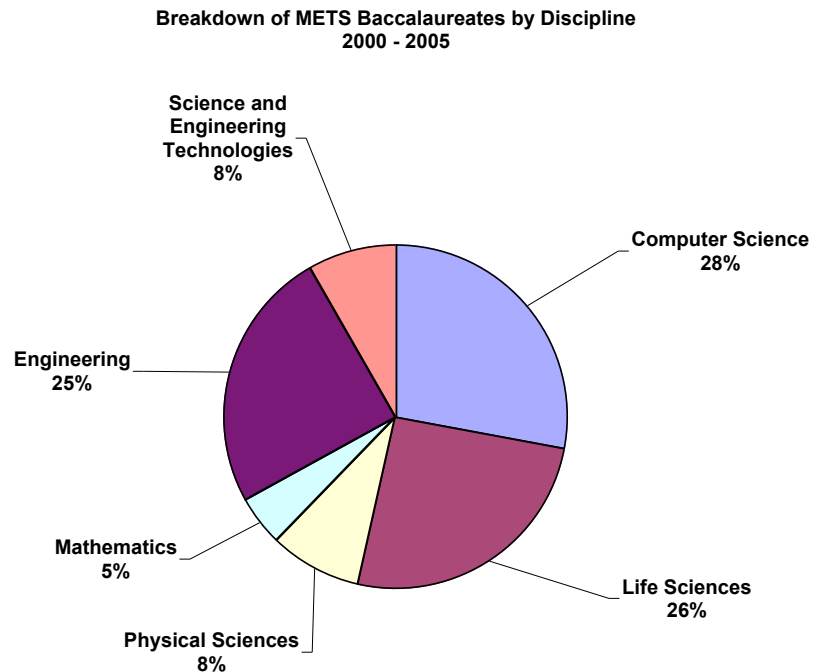
### METS Degrees as a Proportion of All Associates and Baccalaureate Degrees



Source: DHE Administrative Records (EMSAS and IPEDS).

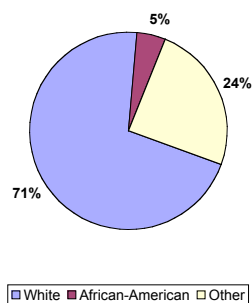
## Degree Production (cont'd.)

Missouri has produced about 4,600 baccalaureate degrees annually in METS since 2000.

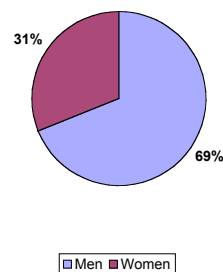


Women and racial/ethnic minorities holding METS degrees are underrepresented relative to their shares of Missouri's population.

METS Degrees Awarded in FY2005 (by Ethnicity)

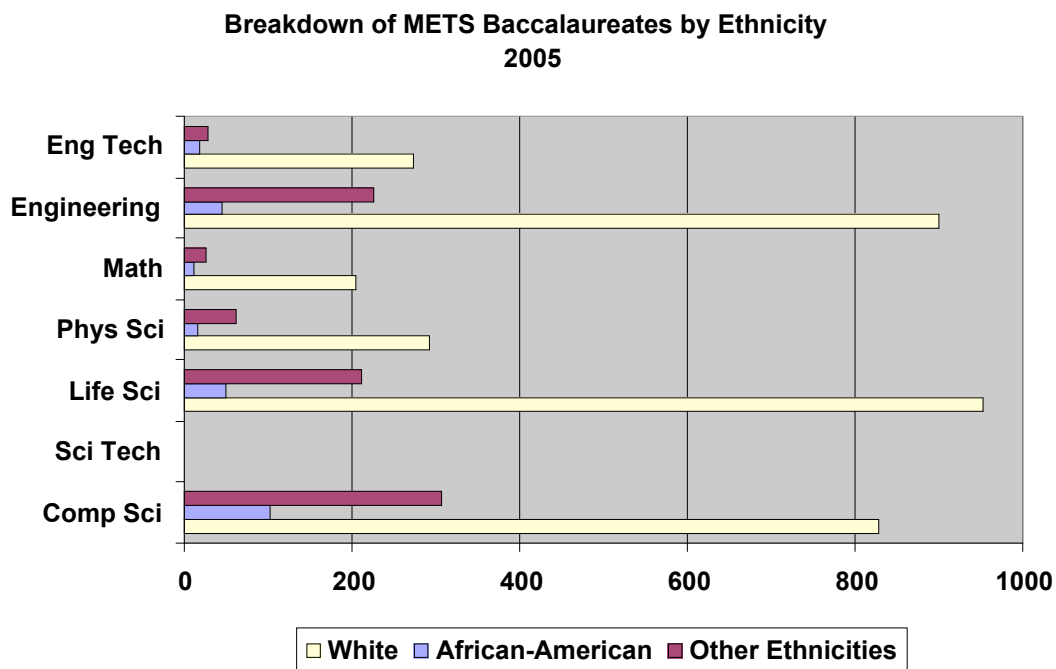
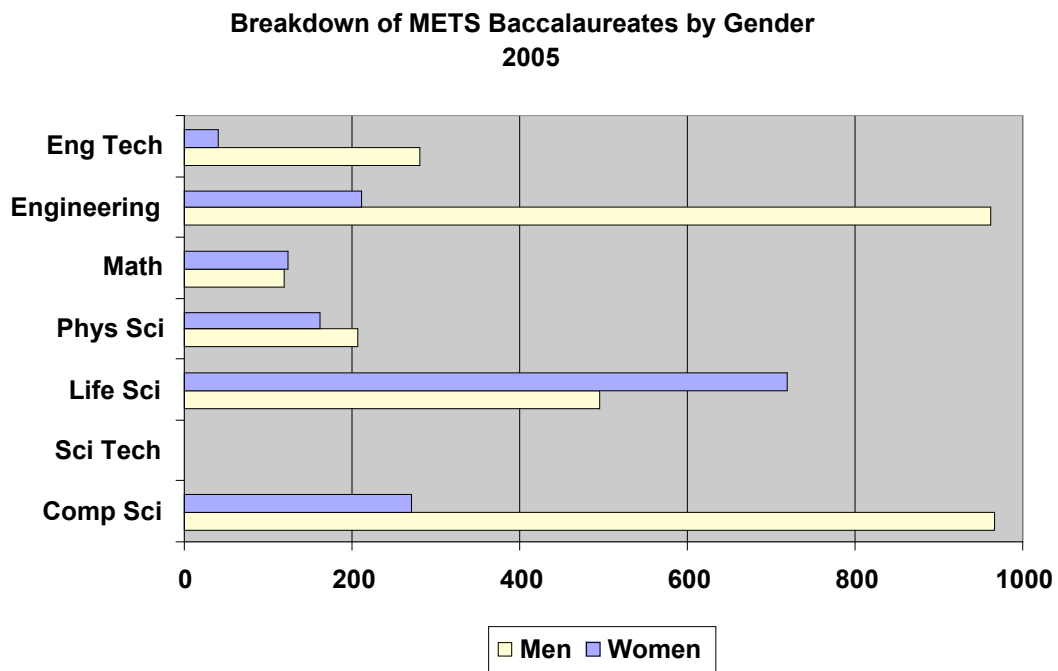


METS Degrees Awarded in FY2005 (by Gender)



Source for all charts on this page: DHE Administrative Records (IPEDS - health excluded).

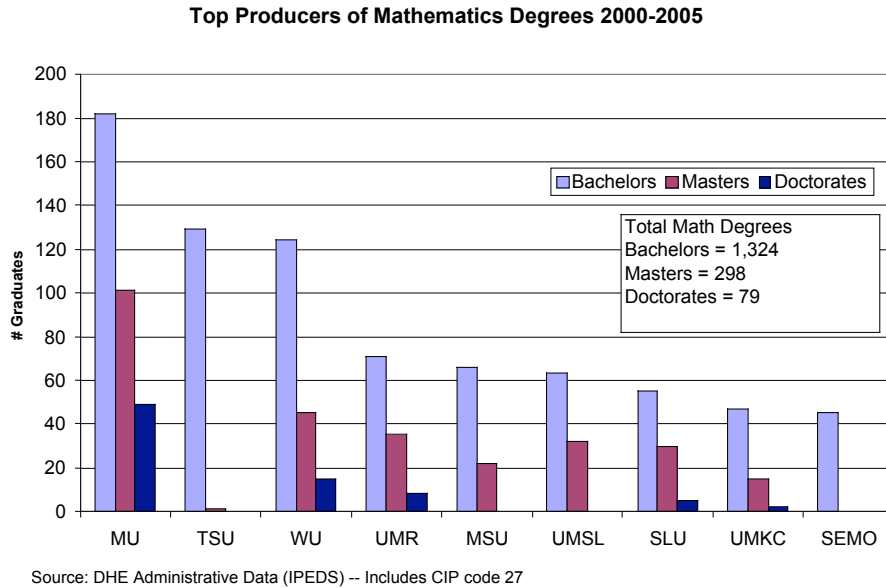
## Degree Production (cont'd.)



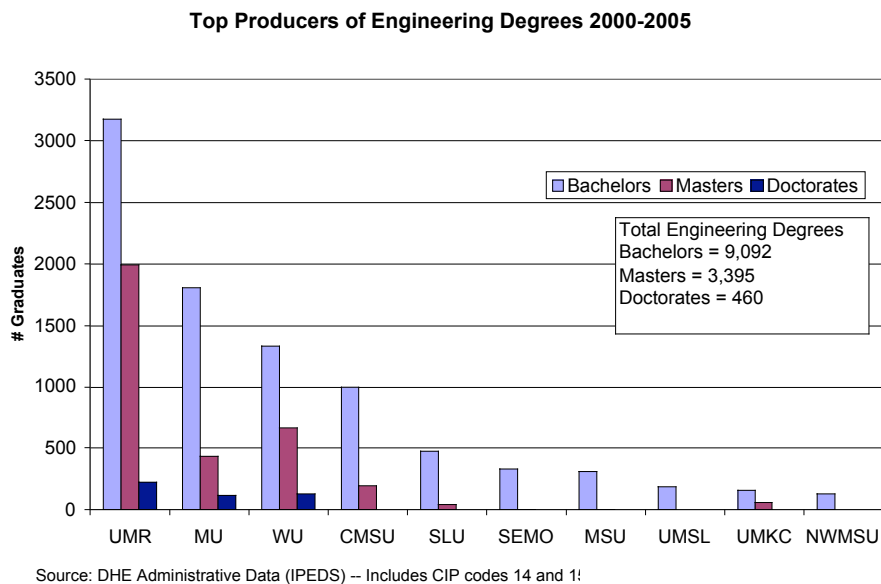
Source: DHE Administrative Records (IPEDS).

## Degree Production (cont'd.)

Capacity in mathematics is concentrated in three institutions.



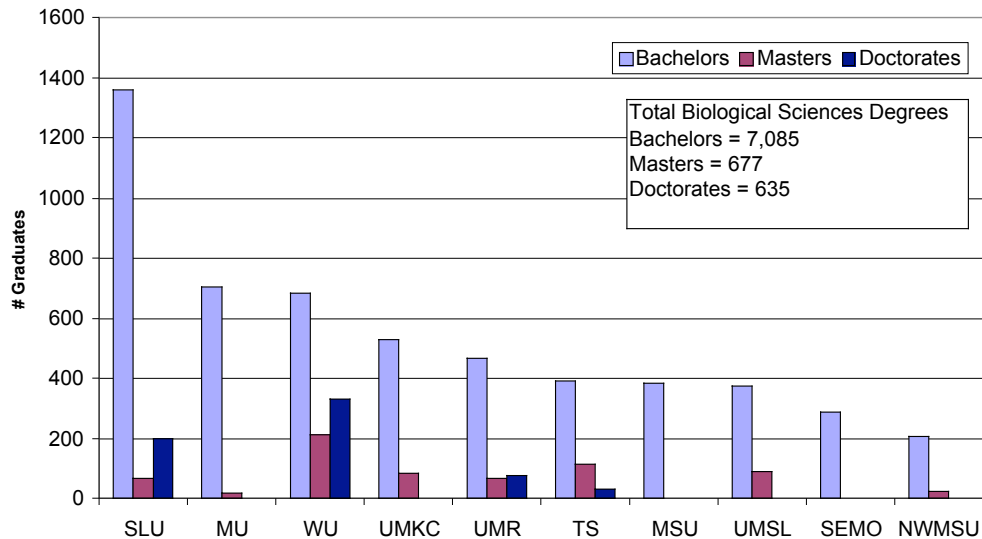
Capacity in engineering is also concentrated.



## Degree Production (cont'd.)

Undergraduate capacity is especially concentrated in the biological sciences.

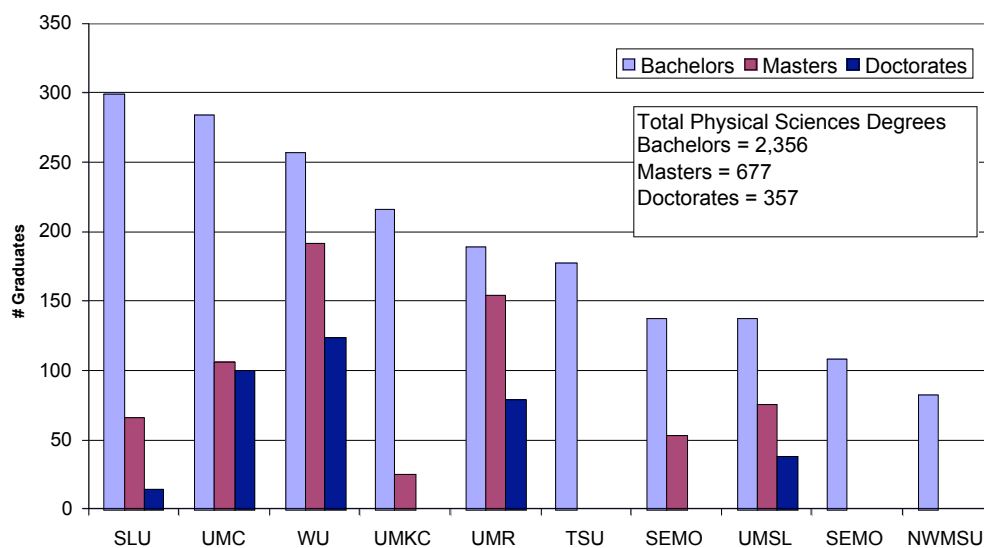
**Top Producers of Biological Sciences Degrees 2000-2005**



Source: DHE Administrative Data (IPEDS) -- Includes CIP code 26

Capacity is more evenly distributed in the physical sciences.

**Top Producers of Physical Sciences Degrees 2000-2005**

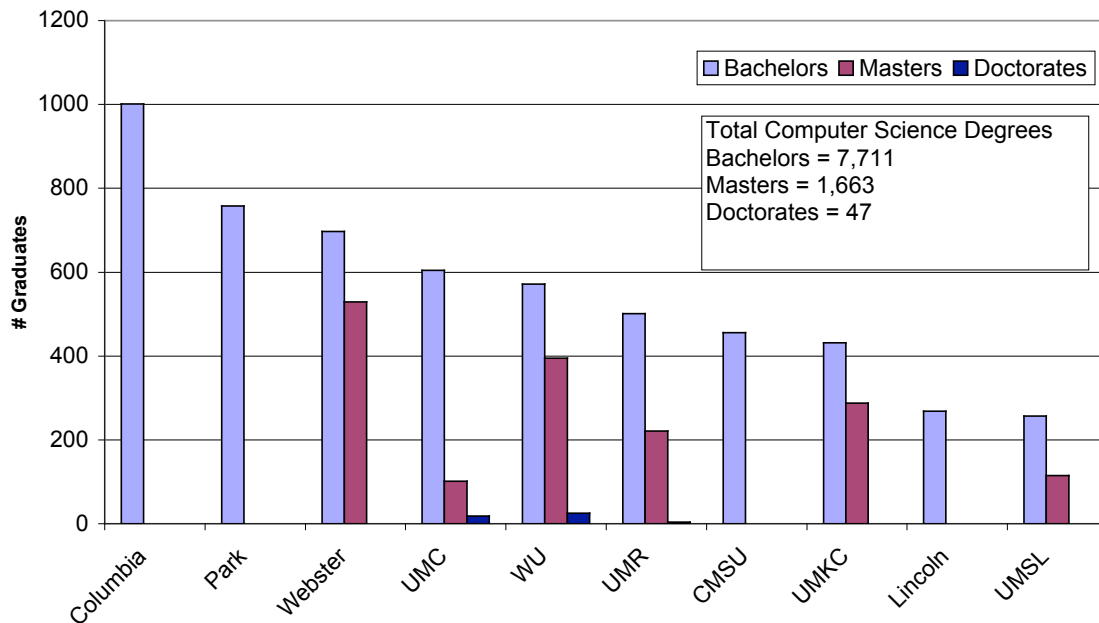


Source: DHE Administrative Data (IPEDS) -- Includes CIP code 40 and 41

## Degree Production (cont'd.)

Computer science degree production is more evenly distributed at the undergraduate levels than at higher levels.

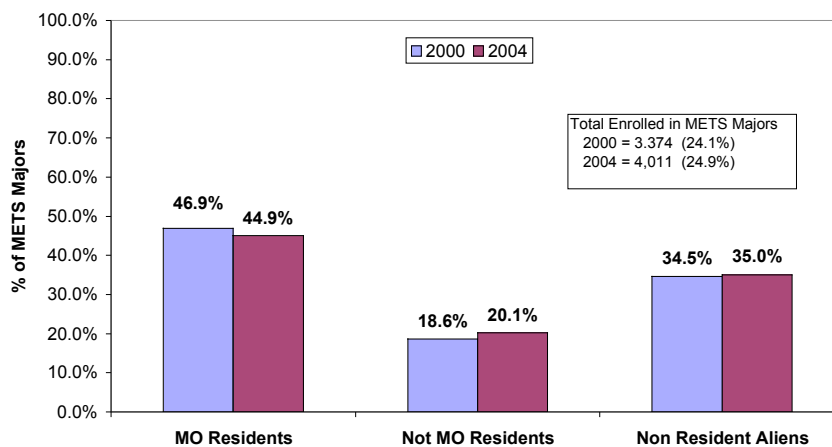
**Top Producers of Computer Science Degrees 2000-2005**



Source: DHE Administrative Data (IPEDS) -- Includes CIP code 11

The shares of foreign and out-of-state students in Missouri METS public graduate programs are growing.

**Geographic Origin of Graduate Students Enrolled in METS Majors in Missouri Public Institutions**

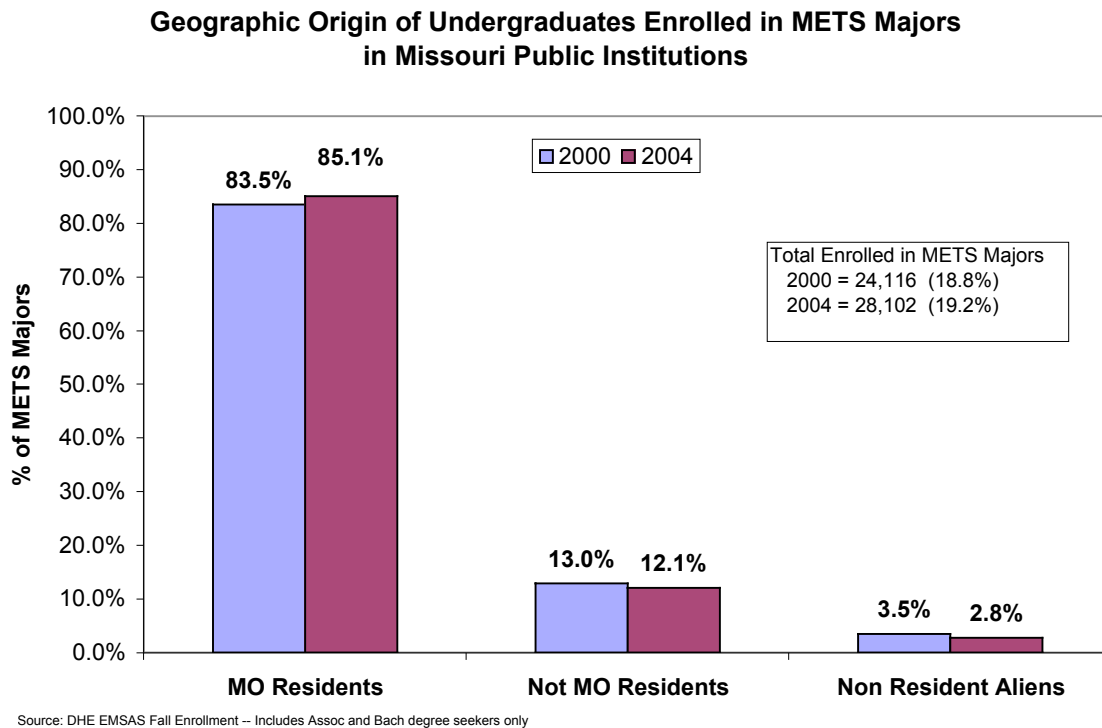


Source: DHE EMSAS Fall Enrollment -- Includes Masters and Doctoral degree seekers only



## Degree Production (cont'd.)

However, the share of Missouri residents enrolled in undergraduate METS programs is growing, while those of other groups have dropped.



## Where Higher Education Stands: The Bottom Line

- Missouri's production of METS degree holders has remained stable, but has not increased despite the state's increasing stake in a knowledge-driven economy.
- The pool of talent prepared and interested in engineering education is strikingly thin.
- Degree production is concentrated in a few institutions, except in the physical sciences.
- Women and racial/ethnic minorities holding METS degrees are underrepresented relative to their share of Missouri's population
- The attrition of undergraduates majoring in METS remains a fundamental problem, while the enrollment of international students in graduate programs remains high.
- The commercialization of university research lags the state's economic development needs.

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## III. What Other States are Doing

### MANY HAVE PARALLEL INITIATIVES

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The National Governors’ Association Center for Best Practices provides a clearinghouse on METS initiatives that states are taking individually and collectively. A review of the materials provided by the NGA confirms that K-12 education is widely viewed as the main bottleneck to building METS capacity. States are concentrating political attention and resources on K-12 in part because employers and the No Child Left Behind Act have made student performance in math and science a front burner issue. At the same time, states recognize that improving foundational skills in METS is not an end in itself. Solutions require tightening the interface between pre-K-12 education, higher education, and the workplace.

The capsule descriptions of activities in this section suggest that many states are undertaking parallel initiatives.

## Statewide Initiatives

### Governors' Summits

**Alabama, Connecticut, Colorado, Florida, Iowa, Massachusetts, Maryland, New Mexico, Rhode Island and Texas** have recently hosted or will host summits to boost student interest and achievement in technical fields. The National Alliance of State Science and Mathematics Coalitions has supported each of these statewide initiatives.

### Needs Assessment

**Minnesota** will convene a Governor's roundtable of business, education, and civic leaders to assess statewide needs for math and science with a follow-up summit for students on METS opportunities and career options.

### New Institutions

**Oregon** has established an Innovation Council to advise the governor and state legislature on business innovation. The state has also appropriated \$7 million to establish an Oregon Nanoscience and Microtechnologies Institute.

# Targeted Initiatives – K-12 METS Teacher Corps

## Recruitment

### 1. Fast-track Certification

**Massachusetts'** fast-track certification proposal would require only a passing score on the teacher subject matter test in math or science. Fast-track teachers would not receive tenure but would receive \$5,000 bonuses as would teachers of AP math or science classes. Mentors of other fast track certified teachers would receive \$3,000 bonuses.

**Connecticut** is proposing an Alternative Route to Certification for those seeking to make mid-career transitions into such hard-to-staff teaching areas as math and science.

### 2. Undergraduate Incentives

**California** has launched a public-private partnership to double the number of University of California undergraduates that are committed to K-12 math and science teaching within five years. Entering freshmen receives an invitation co-signed by the governor and the president of the University of California to consider a specially designed program providing financial aid, subsidized summer institutes, classroom teaching experience, and loan forgiveness.

**Florida** reimburses those teaching in fields suffering from a critical shortage of teachers up to \$10,000 in student loans and up to \$78 per credit hour (up to nine credit hours per year) for courses preparing them to teach in a shortage area.

### 3. Pay Incentives

**Virginia** offers a \$10,000 annual bonus to top math and science teachers who transfer to middle schools struggling in these subjects. Qualified teachers already working at designated schools receive a \$5,000 bonus.

**Florida** is pursuing a \$40 million matching grant program to provide differentiated pay to those teaching in subjects experiencing a shortage of teachers, including math and science.

## *Targeted Initiatives – K-12 METS Teacher Corps (cont'd.)*

### **Improved Professional Development**

#### **1. Pre-Service**

**Minnesota** has received a NGA Honor Grant to improve the alignment among teacher education programs, expected teacher competencies in math and science, and statewide student academic content standards.

Recent **Ohio** legislation requires that teacher preparation program standards be aligned with the state's K-12 academic content standards and testing requirements, including math and science.

**Indiana** has proposed to hold teacher preparation programs accountable for the quality of their METS teachers based on student performance in METS subjects.

#### **2. In-Service**

The **Alabama** Math, Science, and Technology Initiative (AMSTI), administered through state universities and community colleges, provides math and science teachers with intensive professional development, materials, and equipment. AMSTI will serve 250 schools by 2006.

# Targeted Initiatives – Student Performance

## Content, Standards, and Assessments

### 1. American Diploma Project (ADP)

Twenty-two states educating 48% of the nation's students have joined forces with ACHIEVE in a comprehensive effort to ensure that all high school graduates are college- and work-ready. The objective is to raise the rigor of standards, assessments and curriculum to meet the demands of post-secondary education and work.

Rigorous math standards are at the heart of this collaborative effort in which governors, state superintendents of education, business executives, and college and university leaders develop action plans tailored to the needs of participating states. Under the umbrella of the ADP:

- **North Carolina** will require students to pass standardized end-of-course exams in five subjects including biology and algebra 1 beginning with the class of 2010,
- **Michigan** will develop and implement content standards in mathematics and science into a state Merit Exam to be used as a high school assessment and college-entrance exam.
- **Mississippi, Oklahoma, and Pennsylvania** plan to offer ACT's Model Course Syllabi for college preparatory courses in English, mathematics, and science in the sophomore year of high school.
- **Massachusetts** will implement a rigorous end-of-course exam for algebra 2 for the 2007-2008 school year and will also reinstate its dual enrollment program with a focus on math and science.

### 2. Science Standards and Assessments

NCLB requires states to put science standards in place by 2007.

**Minnesota** is proposing to develop an interactive life science state assessment. The state will also expand student access to the College Level Examination Program and replace its Basic Skills Test.

## **Targeted Initiatives – Student Performance (cont'd.)**

**Massachusetts'** students must pass a science exam (biology, chemistry, introductory physics, or technology/engineering) beginning with the class of 2010.

### **3. Expansion of Advanced Placement Math and Science**

**Texas** has reimbursed school districts for the cost of summer institutes of pre-AP math teachers as part of a comprehensive program that has produced a 500% increase in student participation in AP math since 1990.

**Alabama, Georgia, Kentucky, Maine, Nevada, and Wisconsin** are working to improve their disadvantaged students' access to, and success in, AP courses, including math and science.

**Delaware** will require all public high schools to offer AP courses in most content areas, including math and science.

**Arkansas** has mandated that all districts provide advanced placement courses in each of the four core mathematics courses, as well as science, English and social studies by 2008-2009. AP enrollment has more than doubled over the past two years.

### **4. Specialized Math-Science Education**

#### *Residential programs*

**North Carolina, Arkansas, California, South Carolina, and Tennessee** all have established or plan to establish state-funded residential high school programs (summer or year-round) with curricula built around math and science. Some of these schools serve gifted and talented students, while others target populations underrepresented in STEM areas.

#### *Math and Science Academies*

The **Texas** Science Technology, Engineering and Math Initiative (TSTEM), a \$71 million public-private partnership, will create 35 specialized math and science academies designed to serve mostly low-income and minority students in grades 6-12. Five of the schools will serve as professional development centers where teachers can learn best practices.

## ***Targeted Initiatives – Student Performance (cont'd.)***

### ***Technology-Themed High Schools***

The state of **Washington**, with support from the Bill and Melinda Gates Foundation, has committed to scaling up six high-tech high schools based on the nationally-recognized model pioneered in San Diego, California.

**North Carolina** has established eight health and life science-themed high schools with public and private funding.



## Targeted Initiatives - Data Collection and Management

The **Florida** K-20 Education Data Warehouse provides stakeholders in public education the capability of receiving timely, consistent responses to inquiries about Florida's kindergarten through university education (including METS education). It provides a single repository of data concerning students served in the K-20 public education system as well as educational facilities, curriculum, and staff involved in instructional activities (including METS).